Saskatchewan
Environment

Water Pollution
Control Branch

# Lovering Lake Water Quality Assessment 1983-1984

December 1985
WPC 74

# LOVERING LAKE

# WATER QUALITY ASSESSMENT

# 1983-84

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WPC 74

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1. WATER QUALITY MONITORING PARAMETERS AND SAMPLING FREQUENCY
2. DETAILED ESQUADAT WATER QUALITY REPORT

## SUMMARY

Lovering Lake is a small, high-use recreational water body located near Chamberlain, Saskatchewan. Recently, public concern has been expressed over a perceived deterioration in the water quality of the lake particularly related to increased algae and weed growth as well as the occurrence of swimmers' itch at the public beach.

A one year water quality study of Lovering Lake was conducted by the Water Pollution Control Branch of Saskatchewan Environment in 1983-84. The four seasonal surveys were designed to assess the current water quality in terms of the provincial surface water quality objectives and other criteria and also to note differences between seasons and from station to station on the lake.

The water quality features examined during the study included physical and chemical characteristics, bacteria and phytoplankton. Six sample locations were selected for observation and sample collection was done in accordance with standard Water Pollution Control Branch field procedures.

Overall, the results obtained during the study indicated that the water quality was satisfactory for contact and non-contact recreational uses and for protection of aquatic life. Indicator bacteria densities were very low on all sampling dates. The total phosphorus and chlorophyll a concentrations and phytoplankton densities measured indicate Lovering Lake

is a mesotrophic or moderately productive lake. This is characteristic of many small lakes in southern Saskatchewan. The concentrations of heavy metals, biocides and other trace substances in the lake were all below objectives for protection of aquatic life.

The abundant aquatic plant growth present in the shallow areas of Lovering Lake is a natural condition and is the result of nutrients supplied to the plants from natural sources such as decaying organic matter in the sediment and water, and from runoff from farm lands in the area. Mechanical removal in small areas around beaches is the preferred method of control.

The data obtained in this study will provide a useful baseline for future water quality assessments on Lovering Lake.

# 1. INTRODUCTION

## 1.1 Background

Lovering Lake is a small, high-use recreational water body located in south-central Saskatchewan, about 4 km west of Chamberlain. As a recreational lake, it provides an excellent setting for many water-based and other activities including cottaging, boating, swimming and fishing.

Public concern has been expressed recently over a perceived deterioration in the water quality of Lovering Lake. Local residents have suggested that the apparent declining water quality is due to road construction between the two basins of the lake, and the placement of a culvert in this road so that the natural flushing action of spring runoff is inhibited. Complaints regarding the water quality have included increased algae and weed growth as well as the occurrence of swimmers' itch at the public beach.

In order to investigate these concerns, the Water Pollution Control Branch of Saskatchewan Environment conducted a water quality study of Lovering Lake in 1983-84. No water quality related studies had been undertaken on the lake, prior to this study.

## 1.2 Purpose and Scope

The primary purpose of this study is to provide an assessment of Lovering Lake water quality, based on data gathered during four seasonal surveys. This will assist in identifying potential water quality problems and help to determine the causes for perceived water quality concerns and complaints.

Water quality parameters selected for evaluation included physical and chemical characteristics, bacteria, phytoplankton, aquatic macrophytes and sediments.

## 2. STUDY AREA

### 2.1 General Description

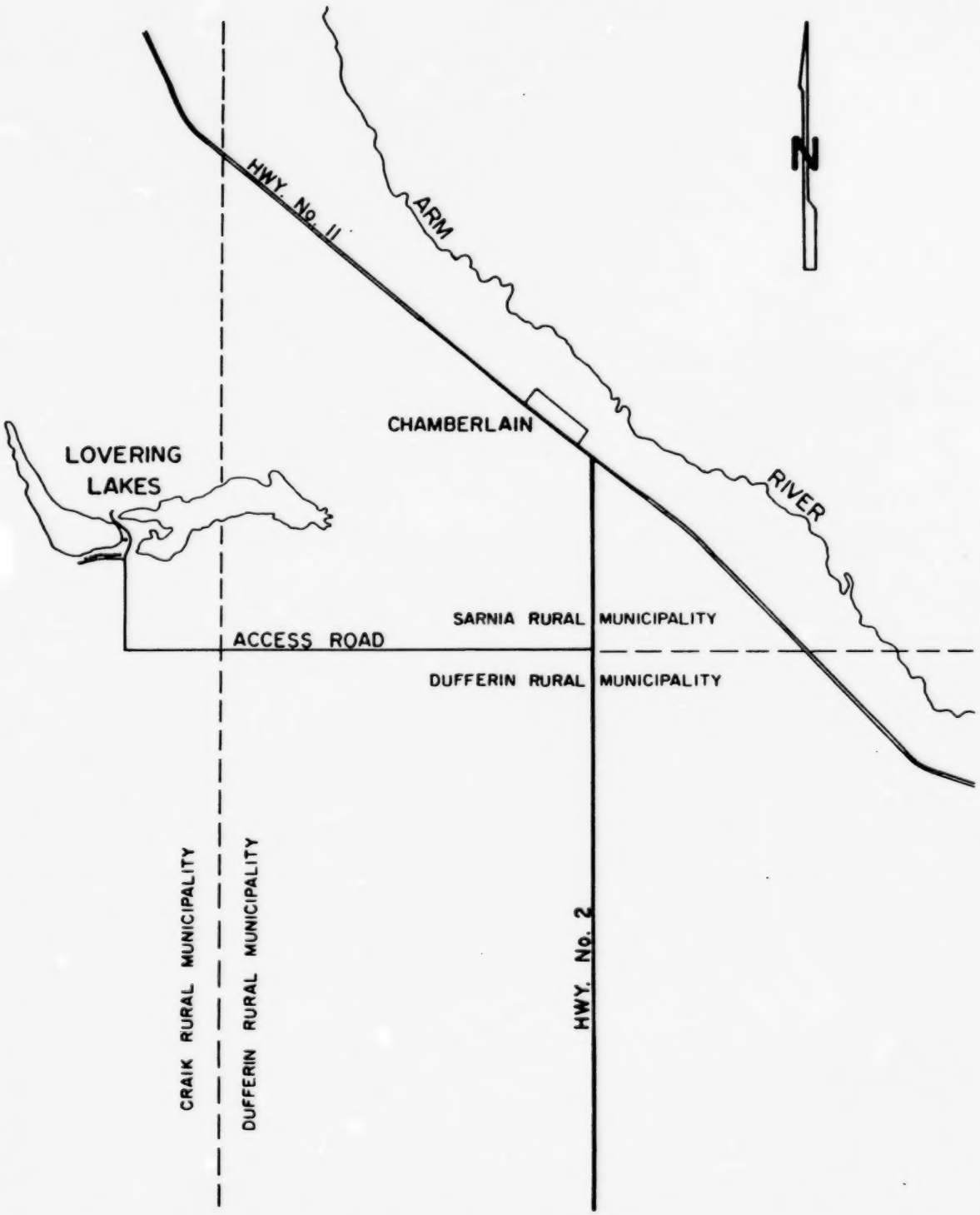
Lovering Lake is located in south-central Saskatchewan in the Rural Municipality of Craik (Figure 1). Access to the lake is via Highway 11 from Regina to Chamberlain, and then by grid road 4 km west to the lake. Lovering Lake is actually comprised of two basins - the west basin, which is developed for use as a recreational water body and is the setting for this study, and the east basin, which is relatively shallow, marshy, and is undeveloped.

Some time ago, a road was constructed between the two basins. This reduced the flow from the west basin to the east, thereby affecting fish movement and spawning activity. Culverts have since been installed in the road but this is still a point of contention among local residents.

The west, or developed, basin of Lovering Lake is a sickle-shaped body of water approximately 28 hectares in size with a maximum total depth of about 15 metres (1). There are some 25 private cottages bordering the south shore of the lake.

The area around Lovering Lake is maintained as a public recreation site by the Department of Parks and Renewable Resources. In addition to the public beach area, there are picnic sites and a boat launch at the east end of the lake.

# FIGURE I LOCATION OF LOVERING LAKE



## 2.2 Topography and Hydrology

Lovering Lake is in the Qu'Appelle Basin Drainage System, although it appears that the lake itself may be self-contained with little or no outflow from the east basin in most years. The topography in the region is level to gently rolling and the land immediately adjacent to the lake is largely grassland.

The water levels of Lovering Lake are likely maintained or recharged by ground water inflow, as there is a significant aquifer system in the area (2) and there is a constant although minor flow between the two basins year round. This ground water flow may impact quite significantly on the water quality of Lovering Lake, since ground water tends to have higher levels of dissolved minerals, iron and manganese.

## 3. WATER QUALITY SURVEILLANCE ACTIVITIES

The Lovering Lake water quality study was carried out by Water Pollution Control Branch staff using standard field procedures during two summer (June 28 and August 9, 1983) and two winter (January 23 and March 6, 1984) visits. The sample collection sites and the significance of these locations is presented in Table 1.

Table 1

LOVERING LAKE SAMPLING LOCATION DESCRIPTIONS

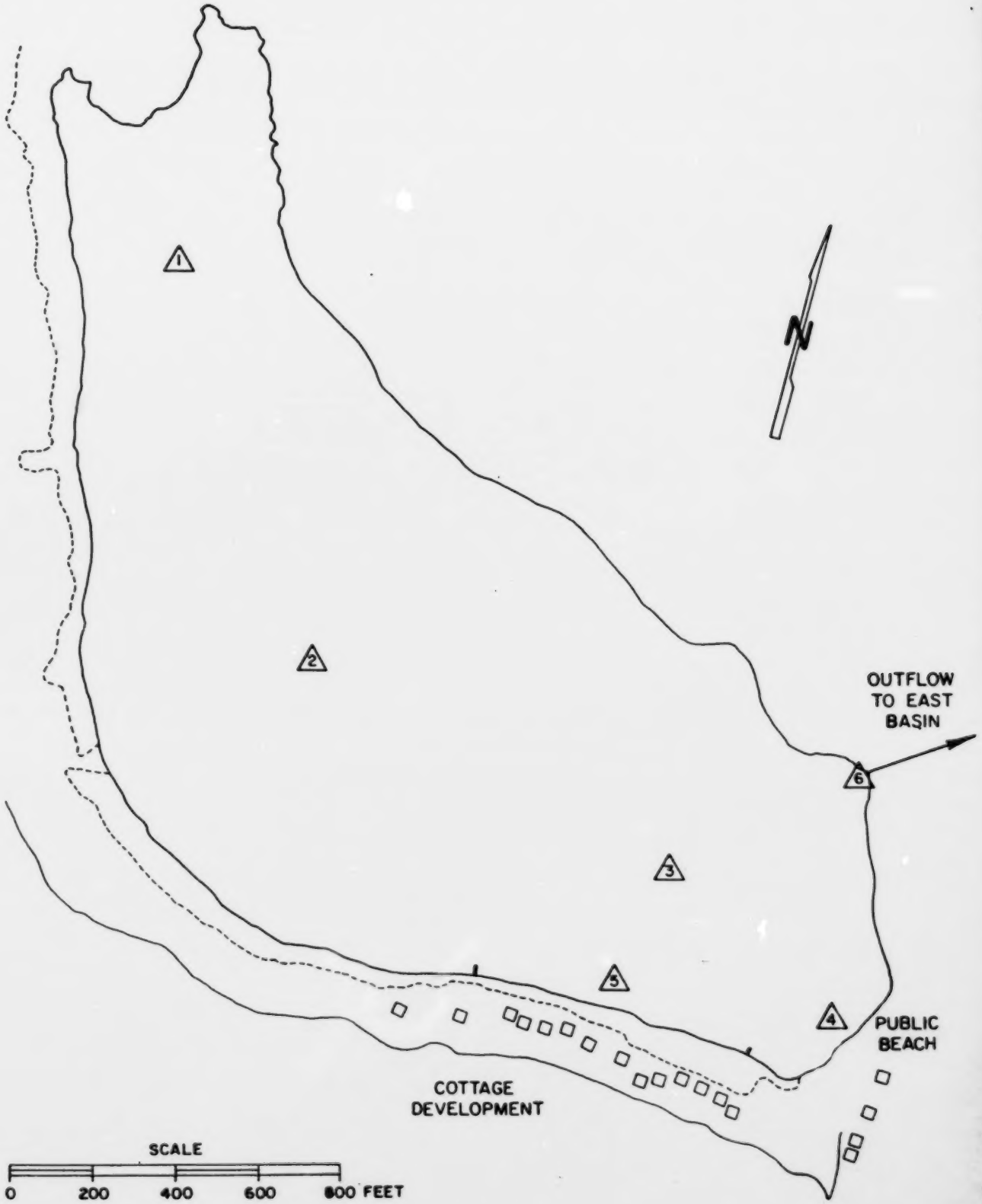
1983-84

| Station No. | Location | Significance |
|---|---|---|
| 1. | mid-lake, NW end | - water quality of shallow northwest end of lake |
| 2. | mid-lake, centre | - water quality of the deep, mid-lake location |
| 3. | mid-lake, SE end | - water quality of shallow, southeast end of lake |
| 4. | opp. public beach | - water quality effects of beach area |
| 5. | opp. cottage development | - water quality effects of cottage development |
| 6. | near road crossing | - water quality at outflow point |

Figure 2 shows the locations of the sample stations on the lake.

A comprehensive list of the monitoring activities including the significant water quality parameters and monitoring frequency at each station is presented in Appendix A. Macrophytes (aquatic plants) were not studied in detail except to note areas of abundant growth.

# FIGURE 2 LOVERING LAKE SAMPLE LOCATIONS



Access to the water sampling stations (Figure 2) was achieved by boat during the open water field surveys and by four-wheel drive truck during the ice covered conditions of the winter surveys. Water samples from shallow shoreline stations (Nos. 1, 4, 5 and 6) were collected with the use of a sampling arm at mid-depth. Composite samples were obtained from the mid-lake stations (Nos. 2 and 3) using an acrylic water sampler specially designed to collect samples at specified depths. These "sub-samples" were then mixed together to create the composite sample required for analysis. All water samples collected for bacteriological analyses were taken at a depth of 0.1 metres. Sediments were collected at Stations 1, 2 and 3 with an Ekman dredge. Samples were placed in whirl-pac bags and kept frozen until analysis.

All water samples were cooled or preserved in the field immediately after collection and then transported to the laboratory for analysis at the completion of each survey. Analysis for general chemical and bacteriological parameters was done by the Provincial Laboratories in Regina. Metals and trace substances in water and sediments were analyzed by the Saskatchewan Research Council. Biocide samples collected during the June, 1983 survey were submitted to the Environment Canada Water Quality Laboratory in Burlington, Ontario, for analysis. Plankton samples were identified by Saskatchewan Environment.

Field measurements were completed in the following manner:

- dissolved oxygen and temperature profiles - were recorded using a YSI Model 57 oxygen meter. Measurements were taken at one metre intervals from the lake surface to just off the lake bottom.
- pH - measured by Metrohm E588 pH meter.
- conductivity - recorded by Beckman RB-5 conductivity meter.
- secchi disk transparency - done only during the two open water surveys using a 20 cm (diameter) secchi disk with alternating black and white quadrants.

## 4. RESULTS AND DISCUSSION

### 4.1 Physical Characteristics

#### 4.1.1 Dissolved Oxygen and Temperature

Dissolved oxygen is a fundamental requirement for aquatic life. Saskatchewan Environment surface water quality objectives recommend a minimum dissolved oxygen concentration of 5.0 milligrams per litre (mg/L) in order to preserve good water quality and protect aquatic life (3). The amount of dissolved oxygen in natural waters varies depending upon temperature, salinity, turbulence (mixing of the water), atmospheric pressure (decreasing with altitude), photosynthesis and respiration by aquatic life.

A review of the dissolved oxygen data for the Lovering Lake water quality study (Table 2), indicates that during the two open water surveys the levels were satisfactory at most stations and were near the saturation point. The exception was at Station 2 where rapid reductions in the oxygen levels were observed below the 8 metre depth in June and below 5 metres in August.

During winter low dissolved oxygen levels were measured at the 1 m depth at Stations 1, 4 and 6 and below the 8 m depth at Station 2.

Table 2

DISSOLVED OXYGEN/TEMPERATURE PROFILES IN LOVERING LAKE, 1983-84

1. June 28, 1983 Survey

| Depth (m) | Station 1 | | | Station 2 | | | Station 3 | | | Station 4 | | | Station 5 | | | Station 6 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D.O. | Temp. | % Sat. | D.O. | Temp. | % Sat. | D.O. | Temp. | % Sat. | D.O. | Temp. | % Sat. | D.O. | Temp. | % Sat. | D.O. | Temp. | % Sat. |
| surf. | 9.7 | 18.5 | 110 | 8.9 | 18.5 | 101 | 8.8 | 18.8 | 100 | 10.0 | 19 | 114 | 8.7 | 18.7 | 99 | 11.1 | 19 | 127 |
| 1.0 | 9.8 | 18.5 | 111 | 8.9 | 18.5 | 101 | 8.8 | 18.8 | 100 | 10.4 | 19 | 119 | 8.7 | 18.7 | 99 | | | |
| 2.0 | 9.5 | 18.5 | 107 | 8.9 | 18.5 | 101 | 8.8 | 18.8 | 100 | | | | 8.7 | 18.7 | 99 | | | |
| 3.0 | | | | 8.9 | 18.5 | 101 | 8.2 | 18.2 | 93 | | | | | | | | | |
| 4.0 | | | | 8.9 | 18.5 | 101 | 8.2 | 18.3 | 92 | | | | | | | | | |
| 5.0 | | | | 8.6 | 18.6 | 97 | 8.1 | 18.2 | 91 | | | | | | | | | |
| 6.0 | | | | 8.0 | 18.0 | 89 | 7.9 | 18.1 | 89 | | | | | | | | | |
| 7.0 | | | | 7.7 | 18.0 | 86 | | | | | | | | | | | | |
| 8.0 | | | | 6.9 | 17.5 | 76 | | | | | | | | | | | | |
| 9.0 | | | | 4.9 | 16.0 | 53 | | | | | | | | | | | | |
| 10.0 | | | | 0.40 | 11.0 | 4 | | | | | | | | | | | | |
| 11.0 | | | | 0.17 | 9.0 | 2 | | | | | | | | | | | | |
| 12.0 | | | | 0.12 | 8.5 | 1 | | | | | | | | | | | | |
| 13.0 | | | | 0.10 | 8.0 | 1 | | | | | | | | | | | | |
| 14.0 | | | | - | - | - | | | | | | | | | | | | |

Table 2 (continued)

DISSOLVED OXYGEN/TEMPERATURE PROFILES IN LOVERING LAKE, 1983-84

2. August 9, 1983 Survey

| Depth (m) | Station 1 | | | Station 2 | | | Station 3 | | | Station 4 | | | Station 5 | | | Station 6 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D.O. | Temp. | % Sat. | D.O. | Temp. | % Sat. | D.O. | Temp. | % Sat. | D.O. | Temp. | % Sat. | D.O. | Temp. | % Sat. | D.O. | Temp. | % Sat. |
| surf. | 7.4 | 23.5 | 93 | 7.8 | 23.0 | 96 | 7.8 | 22 | 94 | 10.6 | 22.5 | 129 | 9.3 | 22 | 112 | 11.5 | 22 | 139 |
| 1.0 | 8.8 | 21.0 | 105 | 8.3 | 22 | 100 | 7.8 | 22 | 94 | 10.9 | 22.5 | 133 | 9.2 | 22 | | | | |
| 2.0 | | | | 8.4 | 22 | 101 | 7.8 | 22 | 94 | | | | | | | | | |
| 3.0 | | | | 8.3 | 22 | 100 | 7.2 | 21.5 | 87 | | | | | | | | | |
| 4.0 | | | | 8.3 | 22 | 100 | 6.3 | 21.5 | 76 | | | | | | | | | |
| 5.0 | | | | 5.8 | 21.5 | 70 | 6.4 | 21.5 | 77 | | | | | | | | | |
| 6.0 | | | | 3.5 | 21.0 | 42 | | | | | | | | | | | | |
| 7.0 | | | | 1.2 | 20.5 | 14 | | | | | | | | | | | | |
| 8.0 | | | | 0 | 18.5 | 0 | | | | | | | | | | | | |
| 9.0 | | | | 0 | 16.5 | 0 | | | | | | | | | | | | |
| 10.0 | | | | 0 | 13 | 0 | | | | | | | | | | | | |
| 11.0 | | | | 0 | 11.5 | 0 | | | | | | | | | | | | |
| 12.0 | | | | 0 | 10.0 | 0 | | | | | | | | | | | | |
| 13.0 | | | | 0 | 9 | 0 | | | | | | | | | | | | |
| 14.0 | | | | 0 | 9 | 0 | | | | | | | | | | | | |

Table 2 (continued)

DISSOLVED OXYGEN/TEMPERATURE PROFILES IN LOVERING LAKE, 1983-84

3. January 23, 1984 Survey

| Depth (m) | Station 1 | | | Station 2 | | | Station 3 | | | Station 4 | | | Station 5 | | | Station 6 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D.O. | Temp. | % Sat. | D.O. | Temp. | % Sat. | D.O. | Temp. | % Sat. | D.O. | Temp. | % Sat. | D.O. | Temp. | % Sat. | D.O. | Temp. | % Sat. |
| surf. | 10.1 | 0.5 | 75 | 9.8 | 1.0 | 74 | 10.4 | 1.4 | 78 | 6.0 | 1.0 | 45 | 11.0 | 0.9 | 83 | 8.8 | 0.7 | 66 |
| 1.0 | 3.4 | 1.0 | 23 | 9.0 | 2 | 69 | 9.2 | 2.2 | 71 | 1.1 | 0.7 | 8 | 9.6 | 2.1 | 74 | 6.7 | 1.0 | 50 |
| 2.0 | | | | 8.8 | 2.2 | 68 | 8.8 | 2.2 | 68 | | | | 8.5 | 2.2 | 66 | | | |
| 3.0 | | | | 8.5 | 2.3 | 66 | 8.5 | 2.2 | 66 | | | | | | | | | |
| 4.0 | | | | 8.1 | 2.3 | 63 | 8.2 | 2.2 | 64 | | | | | | | | | |
| 5.0 | | | | 7.4 | 2.5 | 58 | 7.9 | 2.3 | 61 | | | | | | | | | |
| 6.0 | | | | 6.2 | 2.5 | 48 | 7.4 | 2.3 | 57 | | | | | | | | | |
| 7.0 | | | | 5.2 | 2.8 | 41 | | | | | | | | | | | | |
| 8.0 | | | | 4.2 | 2.8 | 33 | | | | | | | | | | | | |
| 9.0 | | | | 3.5 | 2.8 | 28 | | | | | | | | | | | | |
| 10.0 | | | | 1.95 | 2.9 | 15 | | | | | | | | | | | | |
| 11.0 | | | | 1.75 | 2.9 | 14 | | | | | | | | | | | | |
| 12.0 | | | | | | | | | | | | | | | | | | |
| 13.0 | | | | | | | | | | | | | | | | | | |
| 14.0 | | | | | | | | | | | | | | | | | | |

Table 2 (continued)

DISSOLVED OXYGEN/TEMPERATURE PROFILES IN LOVERING LAKE, 1983-84

4. March 6, 1984 Survey

| Depth (m) | Station 1 | | | Station 2 | | | Station 3 | | | Station 4 | | | Station 5 | | | Station 6 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D.O. | Temp. | % Sat. | D.O. | Temp. | % Sat. | D.O. | Temp. | % Sat. | D.O. | Temp. | % Sat. | D.O. | Temp. | % Sat. | D.O. | Temp. | % Sat. |
| surf. | 8.1 | 1.1 | 61 | 8.1 | 1.1 | 61 | 8.1 | 1.1 | 61 | 4.2 | 1.0 | 31 | 8.2 | 1.3 | 62 | 2.5 | 1.3 | 19 |
| 1.0 | 7.6 | 3.1 | 60 | 7.1 | 4 | 58 | 7.0 | 4.0 | 57 | 1.6 | 1.5 | 12 | 7.8 | 2.8 | 62 | 1.2 | 2.1 | 9 |
| 2.0 | | | | 6.7 | 4 | 55 | 6.7 | 4 | 55 | | | | | | | | | |
| 3.0 | | | | 6.5 | 4 | 53 | 6.6 | 4.1 | 54 | | | | | | | | | |
| 4.0 | | | | 6.3 | 4 | 52 | 6.5 | 4.1 | 53 | | | | | | | | | |
| 5.0 | | | | 6.2 | 4 | 51 | 6.3 | 4.1 | 52 | | | | | | | | | |
| 6.0 | | | | 6.1 | 4 | 50 | 6.1 | 4.1 | 50 | | | | | | | | | |
| 7.0 | | | | 6.1 | 4 | 50 | | | | | | | | | | | | |
| 8.0 | | | | 6.0 | 4.1 | 49 | | | | | | | | | | | | |
| 9.0 | | | | 5.1 | 4.1 | 42 | | | | | | | | | | | | |
| 10.0 | | | | 0.6 | 3.6 | 5 | | | | | | | | | | | | |
| 11.0 | | | | 0.25 | 3.7 | 2 | | | | | | | | | | | | |
| 12.0 | | | | | | | | | | | | | | | | | | |
| 13.0 | | | | | | | | | | | | | | | | | | |
| 14.0 | | | | | | | | | | | | | | | | | | |

These data indicate that during summer, the lake is stratified (layered), preventing complete mixing of the water column, and resulting in a zone of deoxygenated (anoxic) water within and below the thermocline.

Low dissolved oxygen levels in isolated portions of the lake or near the bottom are not a concern as long as fish and other aquatic organisms can move to areas with more satisfactory levels.

### 4.1.2 Conductivity, pH and Transparency

Conductivity is a measure of a water's capacity to convey an electrical current and is an estimate of the concentration of dissolved solids (dissolved mineral salts) in a water body. Conductivity is measured as soon as possible after sample collection because the conductivity of water may change over time.

Table 3 shows the field conductivity measurements for Lovering Lake. A more detailed discussion of the significance of the total dissolved solids in the water is presented in Section 4.2.

The pH is a measure of the acidity or alkalinity of the water. It is determined in the field immediately after sample collection because it can also change rapidly and significantly.

Table 3

FIELD CONDUCTIVITY, pH AND SECCHI DISC MEASUREMENTS IN LOVERING LAKE, 1983-84

| Station | Date Yr-Mo-Day | Time Hr:Min | Specific Conductance us/cm | pH | Secchi Depth metres |
|---|---|---|---|---|---|
| 1 | 83-06-28 | 08:30 | 680 | 8.8 | 1.3* |
| | 83-08-09 | 10:25 | 412 | 8.4 | 1.0* |
| | 84-01-23 | 09:30 | 820 | 8.0 | NR |
| | 84-03-06 | 10:30 | 800 | 8.2 | NR |
| 2 | 83-06-28 | 08:40 | 720 | 8.4 | 5.2 |
| | 83-08-09 | 11:00 | 425 | 8.2 | 6.2 |
| | 84-01-23 | 09:50 | 780 | 8.0 | NR |
| | 84-03-06 | 10:55 | 790 | 8.1 | NR |
| 3 | 83-06-28 | 09:15 | 700 | 8.8 | 5.1 |
| | 83-08-09 | 11:40 | 410 | 8.5 | 4.5 |
| | 84-01-23 | 10:15 | 770 | 8.1 | NR |
| | 84-03-06 | 11:15 | 760 | 8.1 | NR |
| 4 | 83-06-28 | 09:35 | 690 | 8.7 | 0.7* |
| | 83-08-09 | 12:10 | 410 | 8.8 | 0.9* |
| | 84-01-23 | 10:45 | 840 | 7.9 | NR |
| | 84-03-06 | 11:35 | 790 | 8.0 | NR |
| 5 | 83-06-28 | 09:30 | 690 | 8.7 | 1.7* |
| | 83-08-09 | 11:55 | 410 | 8.8 | 1.2* |
| | 84-01-23 | 10:35 | 750 | 8.1 | NR |
| | 84-03-06 | 11:30 | 770 | 8.1 | NR |
| 6 | 83-06-28 | 09:45 | 680 | 8.8 | 0.4* |
| | 83-08-09 | 12:15 | 410 | 8.9 | 1.0* |
| | 84-01-23 | 11:00 | 840 | 7.9 | NR |
| | 84-03-06 | 11:40 | 775 | 7.9 | NR |

Key: NR - not recorded
* - Secchi disc reading to lake bottom.

Saskatchewan Environment surface water quality objectives recommend that the pH of a surface water should be in the range of 6.5 to 8.5 pH units. The pH values for Lovering Lake, presented in Table 3 show most measurements fit into this range. Several values slightly exceeded 8.5 pH units during summer months, but this could be a result of photosynthetic activity of algae and is not considered a problem for normal uses of water in the lake.

The water transparency of Lovering Lake was found to be high during the two surveys in the summer of 1983. The Secchi disc measurements (Table 3) approached the total depth at the shallow near-shore stations and from 4.5 to 6.2 m at mid-lake stations. These data indicate very little in the way of suspended material was present in the water, either in the form of algae blooms or turbidity resulting from wave action or erosion.

## 4.2 Major Ions

Many of the dissolved minerals in the lake water are essential for growth, reproduction and the general well-being of aquatic organisms. The chlorides, carbonates and sulphates of sodium, potassium, calcium and magnesium are generally the most common salts present. Total dissolved solids and major ion data for Lovering Lake are summarized in Appendix B.

Guidelines established for the concentration of total dissolved solids most often relate to taste and palatability of the water rather than detrimental health effects on man and aquatic biota. Results for Lovering Lake, ranging from 500 to 700 mg/L, are typical of prairie lakes in the region. Sulphate is the dominant anion. Ground water flows into the lake likely contribute to this level of dissolved salts. Total dissolved solids concentrations up to 1500 mg/L are considered satisfactory for private water supplies.

Manganese concentrations in most samples exceeded the Saskatchewan Surface Water Quality Objective of 0.05 mg/L (range 0.03 to 0.64 mg/L). These results support the assumption that ground water inflow to the lake is probably affecting water quality. Manganese is of most concern when dealing with a water body as a domestic water supply. The objective of 0.05 mg/L is intended to prevent taste problems and staining of clothing and plumbing fixtures.

### 4.3 Nutrients

Nutrients are an important limiting factor in the growth of all plants. With all factors equal, the rate and profuseness of plant growth (including algae) are proportional to the amount of nutrients available in the system. The most significant nutrients in terms of the enrichment of a water body are nitrogen and phosphorus.



Algae blooms and excessive growth of aquatic plants characterize the condition known as eutrophication, or nutrient enrichment. This excessive plant growth may often interfere with recreational uses of water. The decay of algae and aquatic plants can cause oxygen depletion. The nutrient concentrations measured in Lovering Lake are summarized in Table 4.

Saskatchewan Environment surface water quality objectives suggest that the maximum concentration of nitrogen (combined inorganic and organic) should not exceed 1.0 mg/L. For the purposes of this review, and since the levels of inorganic nitrogen in the form of nitrate and nitrite were almost negligible in Lovering Lake, the value for Total Kjeldahl Nitrogen (TKN) will be considered to represent the total amount of nitrogen available. The values for total nitrogen slightly exceeded the objective of 1.0 mg/L at some stations on Lovering Lake, but this is a typical situation in prairie lakes where surface runoff from fertile farm lands contributes nutrients to the lake.

Ammonia nitrogen, in the unionized state, may be toxic to fish at high concentrations. The proportion of unionized ammonia present depends on pH and water temperature. The highest ammonia nitrogen concentrations were observed at Station 2 on all sampling dates, probably reflecting an accumulation of ammonia nitrogen in the anoxic hypolimnion. At the pH and temperature levels observed, the ammonia nitrogen concentrations in all samples did not exceed the USEPA criteria for protection of freshwater life (9).



### 4.9 Swimmers' Itch

Swimmer's itch is caused by a microscopic parasite which spends part of its life inside some snails. After it emerges from the snails, it finds an intermediate host such as a waterfowl, where it will continue its life cycle. Swimmers' itch occurs when the parasite encounters a human and attempts to burrow into the skin. This activity causes a local irritation and an allergic reaction.

The problem of swimmer's itch is not related to a decline in water quality. The "itch" can be controlled by removing the parasites from the body immediately on emerging from the water. This may be done by towelling the body dry or by taking a shower in fresh water.

Some control can also be achieved by eliminating the snail hosts within beach areas. The preferred chemical is copper sulphate and the method of use and restrictions are outlined in the Saskatchewan Environment booklet (6).



## 5. CONCLUSIONS

The Lovering Lake Water Quality Assessment, 1983-84, was designed to address public concerns regarding the perceived deterioration of the lake water quality, particularly related to increased algae and aquatic plant growth, and the occurrence of swimmers' itch in the beach area.

The study results were assessed in terms of the Saskatchewan surface water quality objectives and other water quality criteria. Overall, the results indicate that the water quality of Lovering Lake is satisfactory for the expected uses of the water. More specific conclusions are provided as follows:

(a) Dissolved oxygen concentrations for most locations on Lovering Lake were better than the surface water quality objective of 5.0 mg/L. Low dissolved oxygen values were measured in isolated portions of the lake, particularly at lower water depths, but are not considered a problem for fish and other aquatic life.

(b) The total dissolved solids concentrations ranged from 500 to 700 mg/L, with sulphates the dominant anion. These levels are typical of a water body that is replenished largely by ground water inflows.

Table 4

NUTRIENT CONCENTRATIONS IN LOVERING LAKE, 1983-84

Parameter (mg/L)

| Station | Date | TKN | $NO_2$-$NO_3$-N | Ammonia N | Total P |
|---|---|---|---|---|---|
| 1 | June/83 | 1.0 | L.03 | .05 | .10 |
| | Aug./83 | 1.1 | L.03 | .12 | .05 |
| | Jan./84 | 1.7 | L.03 | .04 | .11 |
| | Mar./84 | 1.0 | L.03 | .06 | .04 |
| 2 | June/83 | 1.2 | L.03 | .21 | .08 |
| | Aug./83 | 1.3 | .08 | .24 | .10 |
| | Jan./84 | 1.2 | .03 | .24 | .06 |
| | Mar./84 | .9 | .05 | .15 | .03 |
| 3 | June/83 | 1.2 | L.03 | .09 | .06 |
| | Aug./83 | .7 | L.03 | .06 | .05 |
| | Jan./84 | .9 | L.03 | .15 | .05 |
| | Mar./84 | .8 | L.03 | .06 | .03 |
| 4 | June/83 | 1.4 | L.03 | .05 | .06 |
| | Aug./83 | .9 | L.03 | .06 | .06 |
| | Jan./84 | 1.8 | L.03 | .06 | .10 |
| | Mar./84 | 1.0 | L.03 | .03 | .03 |
| 5 | June/83 | 1.1 | L.03 | .10 | .04 |
| | Aug./83 | .9 | L.03 | .04 | .05 |
| | Jan./84 | .9 | .07 | .19 | .05 |
| | Mar./84 | .9 | .07 | .06 | .03 |
| 6 | June/83 | 1.4 | L.03 | .10 | .06 |
| | Aug./83 | .9 | L.03 | .04 | .05 |
| | Jan./84 | 1.2 | L.03 | .10 | .09 |
| | Mar./84 | 1.2 | L.03 | .10 | .04 |



Total phosphorus concentrations in Lovering Lake ranged from 0.03 to 0.11 mg/L during the survey. The mean lake concentration was 0.06 mg/L, slightly higher than the Saskatchewan surface water quality objective of 0.05 mg/L, but typical of small prairie lakes.

## 4.4 Bacteriological Quality

The use potential of surface waters may be limited by the level of contamination of the water with harmful bacteria and other pathogens. In order to obtain an estimate of the potential for health risks associated with water use, the levels of indicator bacteria (total and fecal coliforms and fecal streptococci) are determined. The presence of indicator bacteria at high levels suggests the possibility of fecal contamination and the potential for harmful bacteria being present in the water.

The bacteria densities measured in Lovering Lake are summarized in Table 5. In all cases, the levels were well within the Saskatchewan surface water quality objectives for contact recreation. There was no indication of contamination from human or animal wastes, at any of the locations sampled.

## 4.5 Metals and Trace Substances

Certain metals and trace substances, when present in sufficient concentrations in a lake, may be use-limiting or toxic to aquatic life.



(c) Nutrients, including nitrogen, phosphorus and carbon are present in Lovering Lake in moderate levels. Under conditions of adequate levels of nutrients and warm, shallow water, abundant algae and aquatic plant growth can occur. This is a natural condition and is not the result of water pollution.

(d) In all cases, indicator bacteria densities reported for Lovering Lake were within the surface water quality objectives for contact recreation.

(e) The concentrations of metals and other trace substances in water were within the objectives for protection of aquatic life. Trace metal concentrations in lake sediments were low in comparison to other lakes in southern Saskatchewn.

(f) All biocides analyzed were undetected except for a very low value of 0.002 ug/L for alpha-BHC (Lindane). This compound is commonly detected in low concentrations in prairie lakes and rivers. The concentrations observed are not a concern to human health or aquatic life.

(g) Phytoplankton (algae) densities and chlorophyll a concentrations suggest a mesotrophic productivity status for Lovering Lake.



(h) There are some management or control measures that can be taken when aquatic plant growth or swimmers' itch causes problems in a recreational water body. These are described in the Saskatchewan Environment "Guide to Aquatic Nuisances and Their Control".

(i) Water quality trends could not be assessed because historical data were not available. The 1983-84 study will provide a useful baseline for future assessments.

Table 5

BACTERIA DENSITIES IN LOVERING LAKE, 1983-84

| Station | Date | Total Coliforms (MF)* | Fecal Coliforms (MF) | Fecal Streptococci (MF) |
|---|---|---|---|---|
| 1 | June/83 | 32 | L2 | 4 |
| | Aug./83 | 30 | 3 | 4 |
| | Jan./84 | 4 | L1 | 1 |
| | Mar./84 | 2 | L1 | L1 |
| 2 | June/83 | 9 | L2 | L2 |
| | Aug./83 | 10 | L1 | L1 |
| | Jan./84 | L2 | L1 | L1 |
| | Mar./84 | L2 | L1 | L1 |
| 3 | June/83 | 4 | L2 | L2 |
| | Aug./83 | 2 | L1 | L1 |
| | Jan./84 | L2 | L1 | L1 |
| | Mar./84 | L2 | L1 | L1 |
| 4 | June/83 | 24 | L2 | L2 |
| | Aug./83 | 6 | L1 | L1 |
| | Jan./84 | 8 | L2 | L2 |
| | Mar./84 | L2 | L1 | L1 |
| 5 | June/83 | 14 | L2 | L2 |
| | Aug./83 | 12 | L1 | L1 |
| | Jan./84 | L2 | L1 | L1 |
| | Mar./84 | L2 | L1 | L1 |
| 6 | June/83 | 20 | 2 | 12 |
| | Aug./83 | 0 | 3 | 1 |
| | Jan./84 | L10 | L1 | L1 |
| | Mar./84 | 4 | L1 | L1 |

*MF - analyzed by membrane filtration.
L - less than

The primary natural sources of metals and trace substances is the weathering of rocks and minerals and the degradation of organic material. Man-made sources include municipal and industrial effluents, the combustion of fossil fuels and the application of fertilizers and/or biocides to farm land.

Unlike organic pollutants, metals cannot be degraded biologically or chemically in nature. The metal containing compounds can be altered, but the undesirable metals are still present.

One of the most serious results of the persistence of metals is their biological magnification in the food chain. As a result of this process, the levels of metals in the upper members of the food chain (e.g. fish) can reach values many times higher than those found in the water. This process is particularly evident in the case of the metal mercury.

### 4.5.1 Water

For the Lovering Lake water quality study, the Water Pollution Control Branch collected samples for a wide range of metallic elements and trace substances at stations 1, 2 and 3. Most of the results (Appendix B) obtained were below the Saskatchewan surface water quality objectives. Those parameters that approached or exceeded surface water quality objectives are presented in Table 6.

Table 6

TRACE CONSTITUENTS WHICH APPROACHED OR EXCEEDED SASKATCHEWAN SURFACE WATER QUALITY OBJECTIVES IN LOVERING LAKE, 1983-84

| | Sample Date D M Y HR | Chromium Total MG/L | Copper Total MG/L | Cyanide UG/L | Mercury Total UG/L | Zinc Total MG/L |
|---|---|---|---|---|---|---|
| Station 1 | 28 06 83 0830 | ..003 | .008 | .6 | L.02 | L.001 |
| | 09 08 83 1025 | .03 | .024 | | L.02 | .23 |
| | 23 01 84 0930 | .006 | .013 | .5 | .04 | .073 |
| | 06 03 84 1030 | .008 | .006 | .5 | .15 | .066 |
| | 06 03 84 1035 | .004 | .002 | | | .021 |
| Station 2 | 28 06 83 0840 | .003 | .006 | .4 | L.02 | .01 |
| | 09 08 83 1100 | .011 | .012 | | L.02 | .018 |
| | 09 08 83 1105 | .04 | .018 | | L.02 | .012 |
| | 23 01 84 0950 | .007 | .012 | 2.0 | .34 | .97 |
| | 06 03 84 1055 | .006 | .004 | 3.0 | .02 | .004 |
| | 06 03 84 1100 | .007 | .005 | | .03 | .064 |
| Station 3 | 28 06 83 0915 | .003 | .004 | .5 | L.02 | L.001 |
| | 09 08 83 1140 | .053 | .014 | | L.02 | .48 |
| | 23 01 84 1015 | .096 | .01 | 19.0 | .08 | .48 |
| | 23 01 84 1020 | .005 | .005 | 19.0 | .12 | .14 |
| | 06 03 84 1115 | .006 | .005 | 2.8 | | L.001 |
| | 06 03 84 1120 | .007 | .005 | | | .007 |
| Saskatchewan Surface Water Quality Objective | | 0.05 | 0.02 | 10 | 0.1 | 0.05 |

The toxicity of heavy metals such as zinc and copper is very dependent on the hardness and pH of the water. Toxicity generally decreases with increasing pH and hardness. The US Environmental Protection Agency (EPA) has developed water quality criteria for these parameters which take hardness into account. For Lovering Lake (minimum hardness 308 mg/L as $CaCO_3$) the criterion for copper which would afford protection of aquatic life is 0.038 mg/L (9). The total copper concentrations in all samples collected from Lovering Lake were below this value. Similarly, for zinc the calculated criterion for protection of aquatic life is 0.69 mg/L (10). Only one sample (January, 1984) exceeded this value.

The most recent EPA criterion for total recoverable chromium for protection of aquatic life is 0.011 mg/L (9). This value was exceeded in August, 1983 at each station and in one of two replicate samples collected at station 3 in January, 1984. It is important to note that these EPA criteria for metals may be overly protective since they are based on "total" measurements (10). The few exceedances observed are therefore not considered a concern for the protection of aquatic life in Lovering Lake.

The metal mercury is of more concern as fish can concentrate mercury in their flesh at a level many times greater than is found in the water body (4). As indicated in Table 6, some samples on Lovering Lake slightly exceeded the surface water quality objective of 0.1 ug/L. In 1982, the mercury concentration measured in walleye and pike in Lovering Lake was 0.44 and 0.19 ppm, respectively. These values are within the recommended limit of 0.5 ppm for unlimited consumption. Additional fish samples are to be collected in 1985 by DPRR for mercury analysis as part of an ongoing provincial surveillance program.

Total cyanide concentrations exceeded the Saskatchewan surface water quality objective of 10 ug/L on one occasion (January, 1984) at Station 3. Free cyanide is the form toxic to aquatic life and the proportion of free cyanide in water decreases with increasing pH. Given the ambient pH levels, the maximum cyanide concentration (19 ug/L) measured at Station 3 would not be a concern to fish and other aquatic life in the lake.

Other trace metals found at less than detectable limits in water included beryllium, cadmium, cobalt, molybdenum and selenium.

### 4.5.2 Sediments

Sediments rich in metals and trace constituents may impact significantly on water quality. Effects are most pronounced under anaerobic conditions, when these elements are mobilized into the water as a result of chemical and/or biological action (5).

Sediment samples were collected during the August, 1983 sampling trip at Stations 1, 2 and 3. These samples were submitted to the Saskatchewan Research Council to be analyzed for a wide range of metallic elements and trace constituents by plasma emission technique.

The results (Table 7) indicated that the concentrations of selected constituents are low and are well below values obtained for sediment collected in other lakes in the region such as Buffalo Pound Lake and the Fishing Lakes (Saskatchewan Environment unpublished data).

Table 7

TRACE METAL ANALYSIS OF LOVERING LAKE SEDIMENTS

(ug/g dry weight)

| Parameter | Station 1 | 2 | 3 |
|---|---|---|---|
| Ag | <0.5 | <0.5 | <0.5 |
| Al | 2500 | 12000 | 2000 |
| Ba | 140 | 170 | 140 |
| Be | 1.5 | 5.1 | 1.0 |
| Cd | <0.5 | <0.5 | <0.5 |
| Co | 1.2 | 4.0 | 0.8 |
| Cr | 5.2 | 13 | 5.2 |
| Cu | 3.1 | 10 | 2.0 |
| Fe | 2900 | 10000 | 2100 |
| Mo | 5.4 | 16 | 4.6 |
| Ni | 12 | 11 | 3.7 |
| Pb | <2 | 12 | <0.2 |
| Si | not req | not req | not req |
| Ti | 78 | 5.0 | 58 |
| V | 12 | 33 | 10 |
| W | 2 | 2 | 3 |
| Zn | 20 | 53 | 20 |

## 4.6 Biocides

Biocides are chemical compounds (organic or inorganic) that are used to control noxious "pests" that attack crops, animals and man. Such pests may be insects, weeds or fungi, hence the term biocide includes pesticides, herbicides, fungicides and insecticides.

Biocide samples were collected from Lovering Lake during the June 28, 1983 survey at Stations 1 and 2. The samples were analyzed for two major groups of biocides: phenoxy-acid

herbicides (including 2, 4-D, 2, 4, 5-T, etc.), and organochlorine - 1 compounds (these include lindane, DDT and PCBs).

All constituents were undetected in the analysis except for the compound alpha-BHC (Lindane) which had a very low value of 0.002 ug/L (at the detection limit). Alpha-BHC is quite commonly detected in low levels in prairie lakes and rivers because of its widespread use in the agricultural industry and its tendency to persist in the aquatic environment. The concentration measured in Lovering Lake is not a concern to aquatic life or other known water uses.

## 4.7 Phytoplankton

Phytoplankton densities and chlorophyll a concentrations measured in Lovering Lake are summarized in Table 8. Both densities and chlorophyll a levels were lowest in June, 1983 and highest in January, 1984. Cryptomonads (e.g. Cryptomonas spp., Chroomonas sp., Rhodomonas sp.) were particularly abundant in January, 1984. Dense populations of these algae often develop during cold periods of the year under relatively low light conditions (Wetzel, 1975). Blue-green algae (Cyanophyta) were dominant during the August, 1983 survey but did not reach bloom proportions on the date of sampling. The phytoplankton densities and chlorophyll a concentrations observed suggest a mesotrophic or moderately productive status for Lovering Lake,

Table 8

PHYTOPLANKTON DENSITIES AND CHLOROPHYLL A

CONCENTRATIONS IN LOVERING LAKE, 1983-84

| | Station | Chlorophyta ($cm^3/m^3$) | Chrysophyta ($cm^3/m^3$) | Cyanophyta ($cm^3/m^3$) | Pyrrhophyta ($cm^3/m^3$) | Total Density ($cm^3/m^3$) | Chlorophyll a ($mg/m^3$) |
|---|---|---|---|---|---|---|---|
| 28 June/83 | 1 | 0.07 | 0.69 | 0.14 | 0.03 | 0.93 | 5 |
| | 2 | 0.01 | 0.05 | 0.07 | 0.07 | 0.20 | 5 |
| | 3 | 0.02 | 0.01 | 0.67 | 0.09 | 0.78 | 5 |
| | 4 | 0.04 | 0.10 | 0.22 | 0.24 | 0.60 | 6 |
| | 5 | 0.05 | 0.10 | 0.10 | 0.04 | 0.29 | 5 |
| | 6 | 0.20 | 0.85 | 0.49 | 0.38 | 1.92 | 5 |
| 9 Aug./83 | 1 | 0.01 | 0.12 | 0.18 | 0.10 | 0.41 | 5 |
| | 2 | 0.03 | 0.02 | 1.18 | 0.10 | 1.33 | <1 |
| | 3 | 0.01 | 0.07 | 2.94 | 0.12 | 3.14 | 5 |
| | 4 | 0.24 | 0.62 | 0.59 | 0.03 | 1.48 | <1 |
| | 5 | 0.01 | 0.08 | 0.13 | 0.22 | 0.44 | 27 |
| | 6 | 0.04 | 0.30 | 0.57 | 0.07 | 0.98 | 1 |
| 23 Jan./84 | 1 | 0 | 1.58 | 0.17 | 12.7 | 14.4 | 85 |
| | 2 | 0.01 | 0.30 | 0.03 | 7.3 | 7.6 | - |
| | 3 | 0 | 0.01 | 0 | 0.17 | 0.18 | <1 |
| | 4 | 0 | 0.02 | 0 | 2.39 | 2.41 | 18 |
| | 5 | 0.10 | 2.29 | 0.05 | 2.29 | 4.73 | 18 |
| | 6 | | | | | | 12 |

based on criteria provided in Wetzel (1975). The absence of algae blooms and the relatively high water clarity indicate nutrient enrichment is not excessive.

## 4.8 Aquatic Plants

Public concern regarding the water quality of Lovering Lake has included some complaints about increased growth of aquatic plants in recent years. Observations by Water Pollution Control Branch staff during the water quality survey of 1983-84 noted abundant growth of aquatic macrophytes (rooted plants) in shallow areas of the lake.

The nutrients such as nitrogen, phosphorus and organic carbon are necessary for the growth and development of aquatic plants. These nutrients are supplied to the plants from natural sources such as decaying organic matter in the sediment and water, and from runoff from fertile farm lands in the area. Under conditions of adequate levels of nutrients and warm, shallow water, abundant aquatic plant growth can occur. This would appear to be the situation in Lovering Lake.

Mechanical removal is the preferred method for controlling aquatic plant growth for small areas around beaches and cottage fronts. Chemical control should only be used when mechanical control is not feasible. Details on methods for controlling nuisance aquatic plant growth are described in a booklet prepared by Saskatchewan Environment (6).

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# APPENDIX A

Appendix A

Lovering Lake Water Quality Monitoring Parameters and Frequency of Sampling

| Water Quality Parameters | Month / Station | June, 1983 | | | | | | | August, 1983 | | | | | | | January, 1984 | | | | | | | March, 1984 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | spl | 1 | 2 | 3 | 4 | 5 | 6 | spl | 1 | 2 | 3 | 4 | 5 | 6 | spl | 1 | 2 | 3 | 4 | 5 | 6 | spl |
| Major Ions | | X<br>X | X | X | X | X | X | 7 | X | X | X<br>X | X | X | X | 7 | X<br>X | X | X | X | X | X | 7 | X | X<br>X | X | X | X | X | 7 |
| D.O./Temp. Profiles at 1 m intervals | | X | X | X | X | X | X | 6 | X | X | X | X | X | X | 6 | X | X | X | X | X | X | 6 | X | X | X | X | X | X | 6 |
| cond., pH, Secchi Disc* | | X | X | X | X | X | X | 6 | X | X | X | X | X | X | 6 | X | X | X | X | X | X | 6 | X | X | X | X | X | X | 6 |
| Nutrients | | X | X<br>X | X | X | X | X | 7 | X | X | X<br>X | X | X | X | 7 | X<br>X | X | X | X | X | X | 7 | X | X<br>X | X | X | X | X | 7 |
| Biological (Algae) | | X | X | X | X | X | X | 6 | X | X | X | X | X | X | 6 | X | X | X | X | X | | 5 | - | - | - | - | - | - | 0 |
| Metals & Trace Substances (Water) | | X | X | X | - | - | - | 3 | X | X<br>X | X | - | - | - | 4 | X | X | X<br>X | - | - | - | 4 | X<br>X | X<br>X | X<br>X | - | - | - | 6 |
| Cyanide | | X | X | X | - | - | - | 3 | - | - | - | - | - | - | 0 | - | - | - | - | - | - | 0 | - | - | - | - | - | - | 0 |
| Biocides | | X | X | - | - | - | - | 2 | - | - | - | - | - | - | 0 | - | - | - | - | - | - | 0 | - | - | - | - | - | - | 0 |
| Sulphide (only if low D.O. indicated) | | - | X | - | - | - | - | 1 | - | X | - | - | - | - | 1 | - | X | X | - | - | - | 2 | - | X | X | - | - | - | 2 |
| Metals and Trace Substances (Sediments) | | - | - | - | - | - | - | 0 | X | X | X | - | - | - | 3 | - | - | - | - | - | - | 0 | - | - | - | - | - | - | 0 |
| Bacteria TC, FC, FS, by MF | | X | X<br>X | X | X | X | X | 7 | X | X | X | X<br>X | X | X | 7 | X | X<br>X | X | X | X | X | 7 | X | X | X | X | X<br>X | X | 7 |
| Bacteria TC, FC* by MPN | | - | - | X | X | X | - | 4 | - | - | - | X<br>X | X | - | 3 | - | X<br>X | - | X | X | - | 4 | - | X | - | X | X<br>X | - | 4 |

XX - indicates duplicate samples collected.
* - Secchi disc readings done only during open water surveys.

APPENDIX B

ESQUADAT DETAILED REPORT
SASK ENVIRONMENT DATA (WPCB)

STATION 01SK05140015 LAT. 50D 50M 45S LONG. 105D 35M 45S PR 5 UTM 00 390200E 5633600N

LOVERING LAKE STATION #1 MID-LAKE - N.W. END

| SAMPLE DATE CST D M Y HR | SUBM ID | 07016L NITROGEN TOTAL KJELDAHL N MG/L | 07109L NITROGEN DISSOLVED NO3 & NO2 N MG/L | 07506L NITROGEN TOTAL AMMONIA N MG/L | 15409L PHOSPHORUS TOTAL P MG/L | 15206L PHOSPHORUS SOL. ORTHO P MG/L | 02041L SPECIFIC CONDUCTANCE USIE/CM | 00206L TOTAL DISSOLVED SOLIDS MG/L | 10406L RESIDUE NONFILTR. TSS MG/L |
|---|---|---|---|---|---|---|---|---|---|
| 28 06 83 0830 | 9999 | 1.0 | L.03 | .05 | .10 | .08 | 705. | 557. | 4. |
| 09 08 83 1025 | 9999 | 1.1 | L.03 | .12 | .05 | .06 | 670. | | 2. |
| 23 01 84 0930 | 9999 | 1.7 | L.03 | .03 | .10 | .02 | 875. | 705. | 13. |
| 23 01 84 0935 | 9999 | 1.7 | L.03 | .05 | .11 | .02 | 880. | 717. | 18. |
| 06 03 84 1030 | 9999 | 1.0 | L.03 | .06 | .04 | .01 | 800. | 623. | 4. |

| SAMPLE DATE CST D M Y HR | SUBM ID | 20100L CALCIUM DISSOLVED CA MG/L | 12101L MAGNESIUM DISSOLVED MG MG/L | 19102L POTASSIUM DISSOLVED K MG/L | 11102L SODIUM DISSOLVED NA MG/L | 17204L CHLORIDE DISSOLVED CL MG/L | 16303L SULPHATE DISSOLVED SO4 MG/L | 25451P MANGANESE TOTAL MN MG/L | 26451P IRON TOTAL FE MG/L |
|---|---|---|---|---|---|---|---|---|---|
| 28 06 83 0830 | 9999 | 51. | 55. | 9. | 21. | 16. | 213. 08L | .063 | .03 |
| 09 08 83 1025 | 9999 | 42. | 50. | 9. | 22. | 4. | 210. 08L | .058 | .046 |
| 23 01 84 0930 | 9999 | 69. | 65. | 10. | 25. | 6. | 262. 08L | .27 | .073 |
| 23 01 84 0935 | 9999 | 66. | 69. | 10. | 27. | 6. | 268. 08L | | |
| 06 03 84 1030 | 9999 | 66. | 58. | 8. | 17. | 4. | 216. 08L | .26 | .06 |
| 06 03 84 1035 | 9999 | | | | | | | .26 | .07 |

PARAMETER VALUE CODES

E...ESTIMATED VALUE
H...EXCEEDS VALIDATION LIMITS
K...INSUFFICIENT SAMPLE
N...INTERFERENCE
P...RESULT QUESTIONABLE AND POOR BLANK DEPLETION
L...LESS THAN OR NOT DETECTED
Q...RESULT QUESTIONABLE
R...POOR DEPLETION IN THE BLANK
S...LABORATORY ACCIDENT
T...SAMPLE CONTAINER BROKEN IN TRANSIT
U...RESULTS APPEAR ERRONEOUS
9999....DATA NOT VERIFIED
G...GREATER THAN
V...SUSPECTED SAMPLE CONTAMINATION
W...INACCURATE RESULTS DUE TO SAMPLE AGE
X...NOT COMPLETED DUE TO LACK OF LABORATORY CAPACITY
Y...VERIFIED RESULT
Z...MACHINE MALFUNCTION

ESQUADAT DETAILED REPORT
SASK ENVIRONMENT DATA (WPCB)

STATION 01SK05140015 LAT. 50D 50M 45S LONG. 105D 35M 45S PR 5 UTM 00 390200E 5633500N

LOVERING LAKE STATION #1 MID-LAKE - N.W. END

| SAMPLE DATE CST D M Y HR | SUBM ID | 10603L HARDNESS TOTAL CACO3 MG/L | 10109L ALKALINITY TOTAL CACO3 MG/L | 06708L CHLORO-PHYLL A MG/M3 | 36002L COLIFORMS TOTAL MF NO/100ML | 36012L COLIFORMS FECAL MF NO/100ML | 36102L STREP. FECAL MF NO/100ML | 06117L CARBON ORGANIC DISSOLVED MG/L |
|---|---|---|---|---|---|---|---|---|
| 28 06 83 0830 | 9999 | 356. | 164. | 5. | 32. | L2. | 4. | 8.0 |
| 09 08 83 1025 | 9999 | 308. | 136. | 5. | 30. | 3. | 4. | 9.1 |
| 23 01 84 0930 | 9999 | 440. | 220. | 90. | 4. | L1. | 1. | 8. |
| 23 01 84 0935 | 9999 | 448. | 222. | 79. | | | | 8. |
| 06 03 84 1030 | 9999 | 404. | L8. | 12. | 2. | L1. | L1. | 9. |

| SAMPLE DATE CST D M Y HR | SUBM ID | 13451P ALUMINUM TOTAL AL MG/L | 33006P ARSENIC TOTAL AS UG/L | 56451P BARIUM TOTAL BA MG/L | 05451P BORON TOTAL B MG/L | 24451P CHROMIUM TOTAL CR MG/L | 29451P COPPER TOTAL CU MG/L | 06601P CYANIDE CN UG/L | 82451P LEAD TOTAL PB MG/L |
|---|---|---|---|---|---|---|---|---|---|
| 28 06 83 0830 | 9999 | .03 | 2.1 | .013 | .07 | .003 | .008 | .6 | L.005 |
| 09 08 83 1025 | 9999 | .054 | 1.9 | .011 | .09 | .03 | .024 | | L.005 |
| 23 01 84 0930 | 9999 | .04 | 2.5 | .025 | .10 | .006 | .013 | .5 | .007 |
| 06 03 84 1030 | 9999 | .05 | 1.1 | .019 | .09 | .008 | .006 | .5 | L.005 |
| 06 03 84 1035 | 9999 | .05 | 1.2 | .019 | .09 | .004 | .002 | | L.005 |

| SAMPLE DATE CST D M Y HR | SUBM ID | 80011P MERCURY TOTAL HG UG/L | 28451P NICKEL TOTAL NI MG/L | 14451P SILICON TOTAL SI MG/L | 23451P VANADIUM TOTAL V MG/L | 30451P ZINC TOTAL ZN MG/L | 92001P URANIUM TOTAL U UG/L | 18075L ALPHA-BHC UG/L |
|---|---|---|---|---|---|---|---|---|
| 28 06 83 0830 | 9999 | L.02 | L.001 | .18 | .01 | L.001 | | .002 |
| 09 08 83 1025 | 9999 | L.02 | .012 | .36 | .02 | .23 | | |

PARAMETER VALUE CODES

E...ESTIMATED VALUE
H...EXCEEDS VALIDATION LIMITS
K...INSUFFICIENT SAMPLE
N...INTERFERENCE
P...RESULT QUESTIONABLE AND POOR BLANK DEPLETION
L...LESS THAN OR NOT DETECTED
Q...RESULT QUESTIONABLE
R...POOR DEPLETION IN THE BLANK
S...LABORATORY ACCIDENT
T...SAMPLE CONTAINER BROKEN IN TRANSIT
U...RESULTS APPEAR ERRONEOUS
9999....DATA NOT VERIFIED
G...GREATER THAN
V...SUSPECTED SAMPLE CONTAMINATION
W...INACCURATE RESULTS DUE TO SAMPLE AGE
X...NOT COMPLETED DUE TO LACK OF LABORATORY CAPACITY
Y...VERIFIED RESULT
Z...MACHINE MALFUNCTION

ESQUADAT DETAILED REPORT
SASK ENVIRONMENT DATA (WPCB)

STATION 01SK05140015 LAT. 50D 50M 45S LONG. 105D 35M 45S PR 5 UTM 00 390200E 5633600N

LOVERING LAKE STATION #1 MID-LAKE - N.W. END

| SAMPLE DATE CST D M Y HR | SUBM ID | 80011P MERCURY TOTAL HG UG/L | 28451P NICKEL TOTAL NI MG/L | 14451P SILICON TOTAL SI MG/L | 23451P VANADIUM TOTAL V MG/L | 30451P ZINC TOTAL ZN MG/L | 92001P URANIUM TOTAL U UG/L | 18075L ALPHA-BHC UG/L |
|---|---|---|---|---|---|---|---|---|
| 23 01 84 0930 | 9999 | .04 | .002 | | .02 | .073 | | |
| 06 03 84 1030 | 9999 | Y.15 | .005 | | .02 | .066 | 2.4 | |
| 06 03 84 1035 | 9999 | | L.001 | | .02 | .021 | 2.9 | |

PARAMETER VALUE CODES

E...ESTIMATED VALUE
H...EXCEEDS VALIDATION LIMITS
K...INSUFFICIENT SAMPLE
N...INTERFERENCE
P...RESULT QUESTIONABLE AND POOR BLANK DEPLETION
L...LESS THAN OR NOT DETECTED
Q...RESULT QUESTIONABLE
R...POOR DEPLETION IN THE BLANK
S...LABORATORY ACCIDENT
T...SAMPLE CONTAINER BROKEN IN TRANSIT
U...RESULTS APPEAR ERRONEOUS
9999....DATA NOT VERIFIED
G...GREATER THAN
V...SUSPECTED SAMPLE CONTAMINATION
W...INACCURATE RESULTS DUE TO SAMPLE AGE
X...NOT COMPLETED DUE TO LACK OF LABORATORY CAPACITY
Y...VERIFIED RESULT
Z...MACHINE MALFUNCTION

ESQUADAT DETAILED REPORT
SASK ENVIRONMENT DATA (WPCB)

STATION 01SK05140016 LAT. 50D 50M 40S LONG. 105D 35M 35S PR 5 UTM 00 390200E 5633400N

LOVERING LAKE STATION #2 MID-LAKE - CENTRE

| SAMPLE DATE CST D M Y HR | SUBM ID | 07016L NITROGEN TOTAL KJELDAHL N MG/L | 07109L NITROGEN DISSOLVED NO3 & NO2 N MG/L | 07506L NITROGEN TOTAL AMMONIA N MG/L | 15409L PHOSPHORUS TOTAL P MG/L | 15206L PHOSPHORUS SOL. ORTHO P MG/L | 02041L SPECIFIC CONDUCTANCE USIE/CM | 00206L TOTAL DISSOLVED SOLIDS MG/L | 10406L RESIDUE NONFILTR. TSS MG/L |
|---|---|---|---|---|---|---|---|---|---|
| 28 06 83 0840 | 9999 | 1.1 | L.03 | .22 | .08 | .10 | 731. | 582. | 4. |
| 28 06 83 0842 | 9999 | 1.5 | L.03 | | .13 | | 757. | | |
| 28 06 83 0844 | 9999 | 1.0 | L.03 | | .04 | | 704. | | |
| 28 06 83 0845 | 9999 | 1.2 | L.03 | .21 | .06 | .08 | 726. | 570. | 2. |
| 28 06 83 0846 | 9999 | 1.0 | L.03 | | .04 | | 705. | | |
| 09 08 83 1054 | 9999 | 1.3 | L.03 | | .18 | | 730. | | |
| 09 08 83 1056 | 9999 | .8 | L.03 | | .04 | | 670. | | |
| 09 08 83 1058 | 9999 | .7 | .14 | | .03 | | 660. | | |
| 09 08 83 1100 | 9999 | 1.7 | L.03 | .24 | .14 | .07 | 690. | | 2. |
| 23 01 84 0950 | 9999 | 1.0 | .10 | .24 | .06 | .03 | 810. | 740. | 9. |
| 23 01 84 1000 | 9999 | .8 | L.03 | | .04 | | 795. | | |
| 23 01 84 1005 | 9999 | 1.5 | .03 | | .06 | | 800. | | |
| 23 01 84 1010 | 9999 | 1.2 | L.03 | | .08 | | 830. | | |
| 06 03 84 1040 | 9999 | 1.0 | | | .02 | | 830. | | |
| 06 03 84 1045 | 9999 | .8 | | | .02 | | 820. | | |
| 06 03 84 1050 | 9999 | .9 | | | .05 | | 790. | | |
| 06 03 84 1055 | 9999 | .8 | .03 | .14 | .03 | .02 | 800. | 627. | 2. |
| 06 03 84 1100 | 9999 | .9 | .07 | .17 | .04 | Q.32 | 810. | 623. | 3. |

| SAMPLE DATE CST D M Y HR | SUBM ID | 20100L CALCIUM DISSOLVED CA MG/L | 12101L MAGNESIUM DISSOLVED MG MG/L | 19102L POTASSIUM DISSOLVED K MG/L | 11102L SODIUM DISSOLVED NA MG/L | 17208L CHLORIDE DISSOLVED CL MG/L | 16303L SULPHATE DISSOLVED SO4 MG/L | 25451P MANGANESE TOTAL MN MG/L | 26451P IRON TOTAL FE MG/L |
|---|---|---|---|---|---|---|---|---|---|
| 28 06 83 0840 | 9999 | 59. | 53. | 9. | 22. | 2. | 214. 08L | .27 | .033 |
| 28 06 83 0845 | 9999 | 54. | 53. | 9. | 21. | 6. | 207. 08L | | |
| 09 08 83 1100 | 9999 | 42. | 56. | 9. | 21. | 4. | 214. 08L | .13 | .053 |
| 09 08 83 1105 | 9999 | | | | | | | .14 | .089 |

PARAMETER VALUE CODES

E...ESTIMATED VALUE
H...EXCEEDS VALIDATION LIMITS
K...INSUFFICIENT SAMPLE
N...INTERFERENCE
P...RESULT QUESTIONABLE AND POOR BLANK DEPLETION
L...LESS THAN OR NOT DETECTED
Q...RESULT QUESTIONABLE
R...POOR DEPLETION IN THE BLANK
S...LABORATORY ACCIDENT
T...SAMPLE CONTAINER BROKEN IN TRANSIT
U...RESULTS APPEAR ERRONEOUS
9999....DATA NOT VERIFIED
G...GREATER THAN
V...SUSPECTED SAMPLE CONTAMINATION
W...INACCURATE RESULTS DUE TO SAMPLE AGE
X...NOT COMPLETED DUE TO LACK OF LABORATORY CAPACITY
Y...VERIFIED RESULT
Z...MACHINE MALFUNCTION

ESQUADAT DETAILED REPORT
SASK ENVIRONMENT DATA (WPCB)

STATION 01SK05140016 LAT. 50D 50M 40S LONG. 105D 35M 35S PR 5 UTM 00 390200E 5633400N

LOVERING LAKE STATION #2 MID-LAKE - CENTRE

| SAMPLE DATE CST D M Y HR | SUBM ID | 20100L CALCIUM DISSOLVED CA MG/L | 12101L MAGNESIUM DISSOLVED MG MG/L | 19102L POTASSIUM DISSOLVED K MG/L | 11102L SODIUM DISSOLVED NA MG/L | 17204L CHLORIDE DISSOLVED CL MG/L | 16303L SULPHATE DISSOLVED SO4 MG/L | 25451P MANGANESE TOTAL MN MG/L | 26451P IRON TOTAL FE MG/L |
|---|---|---|---|---|---|---|---|---|---|
| 23 01 84 0950 | 9999 | 62. | 62. | 9. | 23. | 6. | 242. 08L | .30 | .73 |
| 23 01 84 1000 | 9999 | | | | | 4. | | | |
| 23 01 84 1005 | 9999 | | | | | 6. | | | |
| 23 01 84 1010 | 9999 | | | | | 4. | | | |
| 06 03 84 1055 | 9999 | 64. | 60. | 8. | 19. | 4. | 228. 08L | .45 | .062 |
| 06 03 84 1100 | 9999 | 67. | 56. | 8. | 20. | 6. | 220. 08L | .42 | .059 |

| SAMPLE DATE CST D M Y HR | SUBM ID | 10603L HARDNESS TOTAL CACO3 MG/L | 10109L ALKALINITY TOTAL CACO3 MG/L | 06708L CHLORO-PHYLL A MG/M3 | 36002L COLIFORMS TOTAL MF NO/100ML | 36012L COLIFORMS FECAL MF NO/100ML | 36102L STREP. FECAL MF NO/100ML | 06117L CARBON ORGANIC DISSOLVED MG/L |
|---|---|---|---|---|---|---|---|---|
| 28 06 83 0840 | 9999 | 368. | 182. | 5. | 8. | L2. | L2. | 7.5 |
| 28 06 83 0842 | 9999 | | 202. | | | | | 7.2 |
| 28 06 83 0844 | 9999 | | 168. | | | | | 7.1 |
| 28 06 83 0845 | 9999 | 376. | 180. | 5. | 8. | L2. | L2. | 7.3 |
| 28 06 83 0846 | 9999 | | 166. | | | | | 7.3 |
| 09 08 83 1054 | 9999 | | 176. | | | | | S |
| 09 08 83 1056 | 9999 | | 140. | | | | | S |
| 09 08 83 1058 | 9999 | | 132. | L1. | | | | 8.2 |
| 09 08 83 1100 | 9999 | 336. | 148. | L1. | 10. | L1. | L1. | 8.0 |
| 23 01 84 0950 | 9999 | 412. | 202. | L1. | L2. | L1. | L1. | 7. |
| 23 01 84 0955 | 9999 | | | | L2. | L1. | L1. | |
| 23 01 84 1000 | 9999 | | 194. | | | | | 7. |
| 23 01 84 1005 | 9999 | | 200. | | | | | 7. |
| 23 01 84 1010 | 9999 | | 214. | | | | | 7. |
| 06 03 84 1040 | 9999 | | 206. | | | | | 9. |
| 06 03 84 1045 | 9999 | | 200. | | | | | 9. |

PARAMETER VALUE CODES

E...ESTIMATED VALUE
H...EXCEEDS VALIDATION LIMITS
K...INSUFFICIENT SAMPLE
N...INTERFERENCE
P...RESULT QUESTIONABLE AND POOR BLANK DEPLETION
L...LESS THAN OR NOT DETECTED
Q...RESULT QUESTIONABLE
R...POOR DEPLETION IN THE BLANK
S...LABORATORY ACCIDENT
T...SAMPLE CONTAINER BROKEN IN TRANSIT
U...RESULTS APPEAR ERRONEOUS
9999....DATA NOT VERIFIED
G...GREATER THAN
V...SUSPECTED SAMPLE CONTAMINATION
W...INACCURATE RESULTS DUE TO SAMPLE AGE
X...NOT COMPLETED DUE TO LACK OF LABORATORY CAPACITY
Y...VERIFIED RESULT
Z...MACHINE MALFUNCTION

ESQUADAT DETAILED REPORT
SASK ENVIRONMENT DATA (WPCB)

STATION 01SK05140016 LAT. 50D 50M 40S LONG. 105D 35M 35S PR 5 UTM 00 390200E 5633400N

LOVERING LAKE STATION #2 MID-LAKE - CENTRE

| SAMPLE DATE CST D M Y HR | SUBM ID | 10603L HARDNESS TOTAL CACO3 MG/L | 10109L ALKALINITY TOTAL CACO3 MG/L | 06708L CHLORO-PHYLL A MG/M3 | 36002L COLIFORMS TOTAL MF NO/100ML | 36012L COLIFORMS FECAL MF NO/100ML | 36102L STREP. FECAL MF NO/100ML | 06117L CARBON ORGANIC DISSOLVED MG/L |
|---|---|---|---|---|---|---|---|---|
| 06 03 84 1050 | 9999 | | 200. | | | | | 7. |
| 06 03 84 1055 | 9999 | 408. | 200. | L1. | L2. | L1. | L1. | 8. |
| 06 03 84 1100 | 9999 | 400. | 202. | L1. | | | | 9. |

| SAMPLE DATE CST D M Y HR | SUBM ID | 13451P ALUMINUM TOTAL AL MG/L | 33006P ARSENIC TOTAL AS UG/L | 56451P BARIUM TOTAL BA MG/L | 05451P BORON TOTAL B MG/L | 24451P CHROMIUM TOTAL CR MG/L | 29451P COPPER TOTAL CU MG/L | 06601P CYANIDE CN UG/L | 82451P LEAD TOTAL PB MG/L |
|---|---|---|---|---|---|---|---|---|---|
| 28 06 83 0840 | 9999 | .024 | 2.3 | .017 | .07 | .003 | .006 | .4 | L.005 |
| 09 08 83 1100 | 9999 | .032 | 2.1 | .013 | .07 | .011 | 012 | | .006 |
| 09 08 83 1105 | 9999 | .026 | 2.0 | .014 | .09 | .04 | .018 | | .008 |
| 23 01 84 0950 | 9999 | .05 | 2.6 | .023 | .09 | .007 | .012 | 2. | L.005 |
| 06 03 84 1055 | 9999 | .04 | 3.4 | .022 | .1 | .006 | .004 | 3.0 | .005 |
| 06 03 84 1100 | 9999 | .03 | 2.5 | .02 | .1 | .007 | .005 | | L.005 |

| SAMPLE DATE CST D M Y HR | SUBM ID | 80011P MERCURY TOTAL HG UG/L | 28451P NICKEL TOTAL NI MG/L | 14451P SILICON TOTAL SI MG/L | 23451P VANADIUM TOTAL V MG/L | 30451P ZINC TOTAL ZN MG/L | 92001P URANIUM TOTAL U UG/L | 18075L ALPHA-BHC UG/L |
|---|---|---|---|---|---|---|---|---|
| 28 06 83 0840 | 9999 | L.02 | L.001 | .28 | .01 | .01 | | .002 |
| 09 08 83 1100 | 9999 | L.02 | .002 | .12 | .02 | .018 | | |

PARAMETER VALUE CODES

E...ESTIMATED VALUE
H...EXCEEDS VALIDATION LIMITS
K...INSUFFICIENT SAMPLE
N...INTERFERENCE
P...RESULT QUESTIONABLE AND POOR BLANK DEPLETION
L...LESS THAN OR NOT DETECTED
Q...RESULT QUESTIONABLE
R...POOR DEPLETION IN THE BLANK
S...LABORATORY ACCIDENT
T...SAMPLE CONTAINER BROKEN IN TRANSIT
U...RESULTS APPEAR ERRONEOUS
9999....DATA NOT VERIFIED
G...GREATER THAN
V...SUSPECTED SAMPLE CONTAMINATION
W...INACCURATE RESULTS DUE TO SAMPLE AGE
X...NOT COMPLETED DUE TO LACK OF LABORATORY CAPACITY
Y...VERIFIED RESULT
Z...MACHINE MALFUNCTION

ESQUADAT DETAILED REPORT
SASK ENVIRONMENT DATA (WPCB)

STATION 01SK05140016 LAT. 50D 50M 40S LONG. 105D 35M 35S PR 5 UTM 00 390200E 5633400N

LOVERING LAKE STATION #2 MID-LAKE - CENTRE

| SAMPLE DATE CST D M Y HR | SUBM ID | 80011P MERCURY TOTAL HG UG/L | 28451P NICKEL TOTAL NI MG/L | 14451P SILICON TOTAL SI MG/L | 23451P VANADIUM TOTAL V MG/L | 30451P ZINC TOTAL ZN MG/L | 92001P URANIUM TOTAL U UG/L | 18075L ALPHA-BHC UG/L |
|---|---|---|---|---|---|---|---|---|
| 09 08 83 1105 | 9999 | L.02 | .006 | .34 | .02 | .012 | | |
| 23 01 84 0950 | 9999 | Y.34 | L.001 | | .02 | .97 | 2.8 | |
| 06 03 84 1055 | 9999 | .02 | L.001 | | .02 | .004 | 3.4 | |
| 06 03 84 1100 | 9999 | .03 | L.001 | | .02 | .064 | 2.5 | |

PARAMETER VALUE CODES

E...ESTIMATED VALUE
H...EXCEEDS VALIDATION LIMITS
K...INSUFFICIENT SAMPLE
N...INTERFERENCE
P...RESULT QUESTIONABLE AND POOR BLANK DEPLETION
L...LESS THAN OR NOT DETECTED
Q...RESULT QUESTIONABLE
R...POOR DEPLETION IN THE BLANK
S...LABORATORY ACCIDENT
T...SAMPLE CONTAINER BROKEN IN TRANSIT
U...RESULTS APPEAR ERRONEOUS
9999....DATA NOT VERIFIED
G...GREATER THAN
V...SUSPECTED SAMPLE CONTAMINATION
W...INACCURATE RESULTS DUE TO SAMPLE AGE
X...NOT COMPLETED DUE TO LACK OF LABORATORY CAPACITY
Y...VERIFIED RESULT
Z...MACHINE MALFUNCTION

ESQUADAT DETAILED REPORT
SASK ENVIRONMENT DATA (WPCB)

STATION 01SK05140017 LAT. 50D 50M 35S LONG. 105D 35M 20S PR 5 UTM 00 390200E 5633400N

LOVERING LAKE STATION #3 MID-LAKE - S.E. END

| SAMPLE DATE CST D M Y HR | SUBM ID | 07016L NITROGEN TOTAL KJELDAHL N MG/L | 07109L NITROGEN DISSOLVED NO3 & NO2 N MG/L | 07506L NITROGEN TOTAL AMMONIA N MG/L | 15409L PHOSPHORUS TOTAL P MG/L | 15206L PHOSPHORUS SOL. ORTHO P MG/L | 02041L SPECIFIC CONDUCTANCE USIE/CM | 00206L TOTAL DISSOLVED SOLIDS MG/L | 10406L RESIDUE NONFILTR. TSS MG/L |
|---|---|---|---|---|---|---|---|---|---|
| 28 06 83 0915 | 9999 | 1.2 | L.03 | .09 | .06 | .08 | 707. | 588. | 3. |
| 09 08 83 1140 | 9999 | .8 | L.03 | .06 | .06 | .04 | 670. | | 3. |
| 09 08 83 1145 | 9999 | .7 | L.03 | .06 | .04 | .03 | 665. | | 1. |
| 23 01 84 1015 | 9999 | .9 | L.03 | .15 | .05 | .03 | 800. | 651. | 4. |
| 06 03 84 1115 | 9999 | .8 | L.03 | .06 | .03 | .02 | 780. | 631. | 2. |

| SAMPLE DATE CST D M Y HR | SUBM ID | 20100L CALCIUM DISSOLVED CA MG/L | 12101L MAGNESIUM DISSOLVED MG MG/L | 19102L POTASSIUM DISSOLVED K MG/L | 11102L SODIUM DISSOLVED NA MG/L | 17204L CHLORIDE DISSOLVED CL MG/L | 16303L SULPHATE DISSOLVED SO4 MG/L | 25451P MANGANESE TOTAL MN MG/L | 26451P IRON TOTAL FE MG/L |
|---|---|---|---|---|---|---|---|---|---|
| 28 06 83 0915 | 9999 | 50. | 56. | 9. | 22. | 2. | 214. 08L | .05 | .025 |
| 09 08 83 1140 | 9999 | 35. | 56. | 9. | 22. | 4. | 220. 08L | .04 | .072 |
| 09 08 83 1145 | 9999 | | | 9. | 20. | 4. | 220. 08L | | |
| 23 01 84 1015 | 9999 | 54. | 69. | 9. | 22. | 6. | 252. 08L | .16 | .089 |
| 23 01 84 1020 | 9999 | | | | | | | .16 | .082 |
| 06 03 84 1115 | 9999 | 61. | 59. | 8. | 20. | 4. | 240. 08L | .22 | .047 |
| 06 03 84 1120 | 9999 | | | | | | | .23 | .15 |

PARAMETER VALUE CODES

E...ESTIMATED VALUE
H...EXCEEDS VALIDATION LIMITS
K...INSUFFICIENT SAMPLE
N...INTERFERENCE
P...RESULT QUESTIONABLE AND POOR BLANK DEPLETION
L...LESS THAN OR NOT DETECTED
Q...RESULT QUESTIONABLE
R...POOR DEPLETION IN THE BLANK
S...LABORATORY ACCIDENT
T...SAMPLE CONTAINER BROKEN IN TRANSIT
U...RESULTS APPEAR ERRONEOUS
9999....DATA NOT VERIFIED
G...GREATER THAN
V...SUSPECTED SAMPLE CONTAMINATION
W...INACCURATE RESULTS DUE TO SAMPLE AGE
X...NOT COMPLETED DUE TO LACK OF LABORATORY CAPACITY
Y...VERIFIED RESULT
Z...MACHINE MALFUNCTION

ESQUADAT DETAILED REPORT
SASK ENVIRONMENT DATA (WPCB)

STATION 01SK05140017 LAT. 50D 50M 35S LONG. 105D 35M 20S PR 5 UTM 00 390200E 5633400N

LOVERING LAKE STATION #3 MID-LAKE - S.E. END

| SAMPLE DATE CST D M Y HR | SUBM ID | 10603L HARDNESS TOTAL CACO3 MG/L | 10109L ALKALINITY TOTAL CACO3 MG/L | 06708L CHLORO-PHYLL A MG/M3 | 36002L COLIFORMS TOTAL MF NO/100ML | 36012L COLIFORMS FECAL MF NO/100ML | 36102L STREP. FECAL MF NO/100ML | 06117L CARBON ORGANIC DISSOLVED MG/L |
|---|---|---|---|---|---|---|---|---|
| 28 06 83 0915 | 9999 | 366. | 167. | 5. | 4. | L2. | L2. | 8.0 |
| 09 08 83 1140 | 9999 | 320. | 136. | L1. | 2. | L1. | L1. | 8.2 |
| 09 08 83 1145 | 9999 | 320. | 132. | 5. | | | | 8.2 |
| 23 01 84 1015 | 9999 | 420. | 196. | L1. | L2. | L1. | L1. | 7. |
| 06 03 84 1115 | 9999 | 396. | 196. | L1. | L2. | L1. | L1. | 8. |

| SAMPLE DATE CST D M Y HR | SUBM ID | 13451P ALUMINUM TOTAL AL MG/L | 33006P ARSENIC TOTAL AS UG/L | 56451P BARIUM TOTAL BA MG/L | 05451P BORON TOTAL B MG/L | 24451P CHROMIUM TOTAL CR MG/L | 29451P COPPER TOTAL CU MG/L | 06601P CYANIDE CN UG/L | 82451P LEAD TOTAL PB MG/L |
|---|---|---|---|---|---|---|---|---|---|
| 28 06 83 0915 | 9999 | .018 | 2.3 | .014 | .07 | .003 | .004 | .5 | L.005 |
| 09 08 83 1140 | 9999 | .032 | 1.9 | .012 | .07 | .053 | .014 | | .034 |
| 23 01 84 1015 | 9999 | .02 | 2.2 | .028 | .16 | .096 | .01 | 19. | .005 |
| 23 01 84 1020 | 9999 | .02 | 2.3 | .021 | .05 | .005 | .005 | 19. | .007 |
| 06 03 84 1115 | 9999 | .03 | 1.8 | .021 | .1 | .006 | .005 | 2.8 | L.005 |
| 06 03 84 1120 | 9999 | .04 | 1.8 | .019 | .09 | .007 | .005 | | L.005 |

PARAMETER VALUE CODES

E...ESTIMATED VALUE
H...EXCEEDS VALIDATION LIMITS
K...INSUFFICIENT SAMPLE
N...INTERFERENCE
P...RESULT QUESTIONABLE AND POOR BLANK DEPLETION
L...LESS THAN OR NOT DETECTED
Q...RESULT QUESTIONABLE
R...POOR DEPLETION IN THE BLANK
S...LABORATORY ACCIDENT
T...SAMPLE CONTAINER BROKEN IN TRANSIT
U...RESULTS APPEAR ERRONEOUS
9999....DATA NOT VERIFIED
G...GREATER THAN
V...SUSPECTED SAMPLE CONTAMINATION
W...INACCURATE RESULTS DUE TO SAMPLE AGE
X...NOT COMPLETED DUE TO LACK OF LABORATORY CAPACITY
Y...VERIFIED RESULT
Z...MACHINE MALFUNCTION

ESQUADAT DETAILED REPORT
SASK ENVIRONMENT DATA (WPCB)

STATION 01SK05140017 LAT. 50D 50M 35S LONG. 105D 35M 20S PR 5 UTM 00 390200E 5633400N

LOVERING LAKE STATION #3 MID-LAKE - S.E. END

| SAMPLE DATE CST D M Y HR | SUBM ID | 80011P MERCURY TOTAL HG UG/L | 28451P NICKEL TOTAL NI MG/L | 14451P SILICON TOTAL SI MG/L | 23451P VANADIUM TOTAL V MG/L | 30451P ZINC TOTAL ZN MG/L | 92001P URANIUM TOTAL U UG/L | 18075L ALPHA-BHC UG/L |
|---|---|---|---|---|---|---|---|---|
| 28 06 83 0915 | 9999 | L.02 | L.001 | .08 | .01 | L.001 | | |
| 09 08 83 1140 | 9999 | L.02 | .002 | .06 | .02 | .48 | | |
| 23 01 84 1015 | 9999 | .08 | L.001 | | .02 | .48 | 2.9 | |
| 23 01 84 1020 | 9999 | Y.12 | .004 | | .02 | .14 | 2.7 | |
| 06 03 84 1115 | 9999 | T | L.001 | | .02 | L.001 | 2.4 | |
| 06 03 84 1120 | 9999 | T | L.001 | | .02 | .007 | 2.4 | |

E...ESTIMATED VALUE
H...EXCEEDS VALIDATION LIMITS
K...INSUFFICIENT SAMPLE
N...INTERFERENCE
P...RESULT QUESTIONABLE AND POOR BLANK DEPLETION
L...LESS THAN OR NOT DETECTED

PARAMETER VALUE CODES

Q...RESULT QUESTIONABLE
R...POOR DEPLETION IN THE BLANK
S...LABORATORY ACCIDENT
T...SAMPLE CONTAINER BROKEN IN TRANSIT
U...RESULTS APPEAR ERRONEOUS
9999....DATA NOT VERIFIED
G...GREATER THAN

V...SUSPECTED SAMPLE CONTAMINATION
W...INACCURATE RESULTS DUE TO SAMPLE AGE
X...NOT COMPLETED DUE TO LACK OF LABORATORY CAPACITY
Y...VERIFIED RESULT
Z...MACHINE MALFUNCTION

ESQUADAT DETAILED REPORT
SASK ENVIRONMENT DATA (WPCB)

STATION 01SK05140018 LAT. 50D 50M 35S LONG. 105D 35M 15S PR 5 UTM 00 390200E 5633200N

LOVERING LAKE STATION #4 OPPOSITE PUBLIC BEACH

| SAMPLE DATE CST D M Y HR | SUBM ID | 07016L NITROGEN TOTAL KJELDAHL N MG/L | 07109L NITROGEN DISSOLVED NO3 & NO2 N MG/L | 07506L NITROGEN TOTAL AMMONIA N MG/L | 15409L PHOSPHORUS TOTAL P MG/L | 15206L PHOSPHORUS SOL. ORTHO P MG/L | 02041L SPECIFIC CONDUCTANCE USIE/CM | 00206L TOTAL DISSOLVED SOLIDS MG/L | 10406L RESIDUE NONFILTR. TSS MG/L |
|---|---|---|---|---|---|---|---|---|---|
| 28 06 83 0935 | 9999 | 1.4 | L.03 | .05 | .06 | .04 | 703. | 548. | 3. |
| 09 08 83 1210 | 9999 | .9 | L.03 | .06 | .06 | Q.09 | 660. | 491. | 3. |
| 23 01 84 1045 | 9999 | 1.8 | L.03 | .06 | .10 | .02 | 895. | 767. | 12. |
| 06 03 84 1135 | 9999 | 1.0 | L.03 | .03 | .03 | .02 | 820. | 651. | 5. |

| SAMPLE DATE CST D M Y HR | SUBM ID | 20100L CALCIUM DISSOLVED CA MG/L | 12101L MAGNESIUM DISSOLVED MG MG/L | 19102L POTASSIUM DISSOLVED K MG/L | 11102L SODIUM DISSOLVED NA MG/L | 17204L CHLORIDE DISSOLVED CL MG/L | 16303L SULPHATE DISSOLVED SO4 MG/L | 25451P MANGANESE TOTAL MN MG/L | 26451P IRON TOTAL FE MG/L |
|---|---|---|---|---|---|---|---|---|---|
| 28 06 83 0935 | 9999 | 50. | 56. | 9. | 22. | 4. | 216. 08L | | |
| 09 08 83 1210 | 9999 | 38. | 53. | 9. | 22. | 4. | 218. 08L | | |
| 23 01 84 1045 | 9999 | 74. | 67. | 10. | 27. | 6. | 300. 08L | | |
| 06 03 84 1135 | 9999 | 70. | 58. | 8. | 19. | 6. | 224. 08L | | |

| SAMPLE DATE CST D M Y HR | SUBM ID | 10603L HARDNESS TOTAL CACO3 MG/L | 10109L ALKALINITY TOTAL CACO3 MG/L | 06708L CHLORO-PHYLL A MG/M3 | 36002L COLIFORMS TOTAL MF NO/100ML | 36012L COLIFORMS FECAL MF NO/100ML | 36102L STREP. FECAL MF NO/100ML | 06117L CARBON ORGANIC DISSOLVED MG/L |
|---|---|---|---|---|---|---|---|---|
| 28 06 83 0935 | 9999 | 356. | 165. | 6. | 24. | L2. | L2. | 7.7 |
| 09 08 83 1210 | 9999 | 312. | 128. | L1. | 10. | L1. | L1. | 8.6 |
| 09 08 83 1215 | 9999 | | | | L2. | L1. | 1. | |
| 23 01 84 1045 | 9999 | Y460. | 232. | 18. | 8. | L2. | L2. | 8. |

PARAMETER VALUE CODES

E...ESTIMATED VALUE
H...EXCEEDS VALIDATION LIMITS
K...INSUFFICIENT SAMPLE
N...INTERFERENCE
P...RESULT QUESTIONABLE AND POOR BLANK DEPLETION
L...LESS THAN OR NOT DETECTED
Q...RESULT QUESTIONABLE
R...POOR DEPLETION IN THE BLANK
S...LABORATORY ACCIDENT
T...SAMPLE CONTAINER BROKEN IN TRANSIT
U...RESULTS APPEAR ERRONEOUS
9999....DATA NOT VERIFIED
G...GREATER THAN
V...SUSPECTED SAMPLE CONTAMINATION
W...INACCURATE RESULTS DUE TO SAMPLE AGE
X...NOT COMPLETED DUE TO LACK OF LABORATORY CAPACITY
Y...VERIFIED RESULT
Z...MACHINE MALFUNCTION

ESQUADAT DETAILED REPORT
SASK ENVIRONMENT DATA (WPCB)

STATION 01SK05140018 LAT. 50D 50M 35S LONG. 105D 35M 15S PR 5 UTM 00 390200E 5633200N

LOVERING LAKE STATION #4 OPPOSITE PUBLIC BEACH

| SAMPLE DATE CST D M Y HR | SUBM ID | 10603L HARDNESS TOTAL CACO3 MG/L | 10109L ALKALINITY TOTAL CACO3 MG/L | 06708L CHLORO-PHYLL A MG/M3 | 36002L COLIFORMS TOTAL MF NO/100ML | 36012L COLIFORMS FECAL MF NO/100ML | 36102L STREP. FECAL MF NO/100ML | 06117L CARBON ORGANIC DISSOLVED MG/L |
|---|---|---|---|---|---|---|---|---|
| 06 03 84 1135 | 9999 | 416. | 218. | L1. | L2. | L1. | L1. | 9. |

PARAMETER VALUE CODES

E...ESTIMATED VALUE
H...EXCEEDS VALIDATION LIMITS
K...INSUFFICIENT SAMPLE
N...INTERFERENCE
P...RESULT QUESTIONABLE AND POOR BLANK DEPLETION
L...LESS THAN OR NOT DETECTED
Q...RESULT QUESTIONABLE
R...POOR DEPLETION IN THE BLANK
S...LABORATORY ACCIDENT
T...SAMPLE CONTAINER BROKEN IN TRANSIT
U...RESULTS APPEAR ERRONEOUS
9999....DATA NOT VERIFIED
G...GREATER THAN
V...SUSPECTED SAMPLE CONTAMINATION
W...INACCURATE RESULTS DUE TO SAMPLE AGE
X...NOT COMPLETED DUE TO LACK OF LABORATORY CAPACITY
Y...VERIFIED RESULT
Z...MACHINE MALFUNCTION

ESQUADAT DETAILED REPORT
SASK ENVIRONMENT DATA (WPCB)

STATION 01SK05140019 LAT. 50D 50M 35S LONG. 105D 35M 20S PR 5 UTM 00 390200E 5633200N

LOVERING LAKE STATION #5 OPPOSITE COTTAGE DEVELOPMENT

| SAMPLE DATE CST D M Y HR | SUBM ID | 07016L NITROGEN TOTAL KJELDAHL N MG/L | 07109L NITROGEN DISSOLVED NO3 & NO2 N MG/L | 07506L NITROGEN TOTAL AMMONIA N MG/L | 15409L PHOSPHORUS TOTAL P MG/L | 15206L PHOSPHORUS SOL. ORTHO P MG/L | 02041L SPECIFIC CONDUCTANCE USIE/CM | 00206L TOTAL DISSOLVED SOLIDS MG/L | 10406L RESIDUE NONFILTR. TSS MG/L |
|---|---|---|---|---|---|---|---|---|---|
| 28 06 83 0930 | 9999 | 1.1 | L.03 | .10 | .04 | .05 | 710. | 554. | 1. |
| 09 08 83 1155 | 9999 | .9 | L.03 | .04 | .05 | .04 | 670. | | 1. |
| 23 01 84 1035 | 9999 | .9 | .07 | .19 | .05 | .02 | 810. | 646. | 3. |
| 06 03 84 1130 | 9999 | .9 | .07 | .06 | .03 | .02 | 800. | 619. | 4. |

| SAMPLE DATE CST D M Y HR | SUBM ID | 20100L CALCIUM DISSOLVED CA MG/L | 12101L MAGNESIUM DISSOLVED MG MG/L | 19102L POTASSIUM DISSOLVED K MG/L | 11102L SODIUM DISSOLVED NA MG/L | 17204L CHLORIDE DISSOLVED CL MG/L | 16303L SULPHATE DISSOLVED SO4 MG/L | 25451P MANGANESE TOTAL MN MG/L | 26451P IRON TOTAL FE MG/L |
|---|---|---|---|---|---|---|---|---|---|
| 28 06 83 0930 | 9999 | 51. | 55. | 9. | 22. | 6. | 214. 08L | | |
| 09 08 83 1155 | 9999 | 35. | 56. | 9. | 21. | 6. | 220. 08L | | |
| 23 01 84 1035 | 9999 | 67. | 58. | 9. | 24. | 6. | 240. 08L | | |
| 06 03 84 1130 | 9999 | 66. | 58. | 8. | 20. | 4. | 224. 08L | | |

| SAMPLE DATE CST D M Y HR | SUBM ID | 10603L HARDNESS TOTAL CACO3 MG/L | 10109L ALKALINITY TOTAL CACO3 MG/L | 06708L CHLORO-PHYLL A MG/M3 | 36002L COLIFORMS TOTAL MF NO/100ML | 36012L COLIFORMS FECAL MF NO/100ML | 36102L STREP. FECAL MF NO/100ML | 06117L CARBON ORGANIC DISSOLVED MG/L |
|---|---|---|---|---|---|---|---|---|
| 28 06 83 0930 | 9999 | 356. | 167. | 5. | 14. | L2. | L2. | 7.5 |
| 09 08 83 1155 | 9999 | 320. | 132. | 27. | 12. | L1. | L1. | 8.3 |
| 23 01 84 1035 | 9999 | 408. | 198. | 18. | L2. | L1. | L1. | 8. |
| 06 03 84 1130 | 9999 | 404. | 196. | L1. | L2. | L1. | L1. | 8. |

PARAMETER VALUE CODES

E...ESTIMATED VALUE
H...EXCEEDS VALIDATION LIMITS
K...INSUFFICIENT SAMPLE
N...INTERFERENCE
P...RESULT QUESTIONABLE AND POOR BLANK DEPLETION
L...LESS THAN OR NOT DETECTED
Q...RESULT QUESTIONABLE
R...POOR DEPLETION IN THE BLANK
S...LABORATORY ACCIDENT
T...SAMPLE CONTAINER BROKEN IN TRANSIT
U...RESULTS APPEAR ERRONEOUS
9999....DATA NOT VERIFIED
G...GREATER THAN
V...SUSPECTED SAMPLE CONTAMINATION
W...INACCURATE RESULTS DUE TO SAMPLE AGE
X...NOT COMPLETED DUE TO LACK OF LABORATORY CAPACITY
Y...VERIFIED RESULT
Z...MACHINE MALFUNCTION

ESQUADAT DETAILED REPORT
SASK ENVIRONMENT DATA (WPCB)

STATION 01SK05140019 LAT. 50D 50M 35S LONG. 105D 35M 20S PR 5 UTM 00 390200E 5633200N

LOVERING LAKE STATION #5 OPPOSITE COTTAGE DEVELOPMENT

| SAMPLE DATE CST D M Y HR | SUBM ID | 10603L HARDNESS TOTAL CACO3 MG/L | 10109L ALKALINITY TOTAL CACO3 MG/L | 06708L CHLORO-PHYLL A MG/M3 | 36002L COLIFORMS TOTAL MF NO/100ML | 36012L COLIFORMS FECAL MF NO/100ML | 36102L STREP. FECAL MF NO/100ML | 06117L CARBON ORGANIC DISSOLVED MG/L |
|---|---|---|---|---|---|---|---|---|
| 06 03 84 1135 | 9999 | | | | L2. | L1. | L1. | |

PARAMETER VALUE CODES

E...ESTIMATED VALUE
H...EXCEEDS VALIDATION LIMITS
K...INSUFFICIENT SAMPLE
N...INTERFERENCE
P...RESULT QUESTIONABLE AND POOR BLANK DEPLETION
L...LESS THAN OR NOT DETECTED
Q...RESULT QUESTIONABLE
R...POOR DEPLETION IN THE BLANK
S...LABORATORY ACCIDENT
T...SAMPLE CONTAINER BROKEN IN TRANSIT
U...RESULTS APPEAR ERRONEOUS
9999....DATA NOT VERIFIED
G...GREATER THAN
V...SUSPECTED SAMPLE CONTAMINATION
W...INACCURATE RESULTS DUE TO SAMPLE AGE
X...NOT COMPLETED DUE TO LACK OF LABORATORY CAPACITY
Y...VERIFIED RESULT
Z...MACHINE MALFUNCTION

ESQUADAT DETAILED REPORT
SASK ENVIRONMENT DATA (WPCB)

STATION 01SK05140020 LAT. 50D 50M 40S LONG. 105D 35M 20S PR 5 UTM 00 390200E 5633400N

LOVERING LAKE STATION #6 OPPOSITE ROAD CROSSING (OUTFLOW)

| SAMPLE DATE CST D M Y HR | SUBM ID | 07016L NITROGEN TOTAL KJELDAHL N MG/L | 07109L NITROGEN DISSOLVED NO3 & NO2 N MG/L | 07506L NITROGEN TOTAL AMMONIA N MG/L | 15409L PHOSPHORUS TOTAL P MG/L | 15206L PHOSPHORUS SOL. ORTHO P MG/L | 02041L SPECIFIC CONDUCTANCE USIE/CM | 00206L TOTAL DISSOLVED SOLIDS MG/L | 10406L RESIDUE NONFILTR. TSS MG/L |
|---|---|---|---|---|---|---|---|---|---|
| 28 06 83 0945 | 9999 | 1.4 | L.03 | .10 | .06 | .03 | 703. | 542. | 5. |
| 09 08 83 1215 | 9999 | .9 | L.03 | .04 | .05 | .04 | 663. | | 1. |
| 23 01 84 1100 | 9999 | 1.2 | L.03 | .10 | .09 | .03 | 860. | 679. | |
| 06 03 84 1140 | 9999 | 1.2 | L.03 | .10 | .04 | .02 | 820. | 647. | 6. |

| SAMPLE DATE CST D M Y HR | SUBM ID | 20100L CALCIUM DISSOLVED CA MG/L | 12101L MAGNESIUM DISSOLVED MG MG/L | 19102L POTASSIUM DISSOLVED K MG/L | 11102L SODIUM DISSOLVED NA MG/L | 17204L CHLORIDE DISSOLVED CL MG/L | 16303L SULPHATE DISSOLVED SO4 MG/L | 25451P MANGANESE TOTAL MN MG/L | 26451P IRON TOTAL FE MG/L |
|---|---|---|---|---|---|---|---|---|---|
| 28 06 83 0945 | 9999 | 51. | 55. | 8. | 22. | 6. | 216. 08L | | |
| 09 08 83 1215 | 9999 | 35. | 53. | 9. | 22. | 8. | 218. 08L | | |
| 23 01 84 1100 | 9999 | 69. | 62. | 10. | 26. | 6. | 240. 08L | | |
| 06 03 84 1140 | 9999 | 74. | 57. | 8. | 18. | 6. | 208. 08L | | |

| SAMPLE DATE CST D M Y HR | SUBM ID | 10603L HARDNESS TOTAL CACO3 MG/L | 10109L ALKALINITY TOTAL CACO3 MG/L | 06708L CHLORO-PHYLL A MG/M3 | 36002L COLIFORMS TOTAL MF NO/100ML | 36012L COLIFORMS FECAL MF NO/100ML | 36102L STREP. FECAL MF NO/100ML | 06117L CARBON ORGANIC DISSOLVED MG/L |
|---|---|---|---|---|---|---|---|---|
| 28 06 83 0945 | 9999 | 356. | 161. | 5. | 20. | 2. | 12. | 7.2 |
| 09 08 83 1215 | 9999 | 308. | 128. | 1. | N | 3. | 1. | 8.5 |
| 23 01 84 1100 | 9999 | 428. | 218. | 12. | L10. | L1. | L1. | 8. |
| 06 03 84 1140 | 9999 | 420. | 226. | L1. | 4. | L1. | L1. | 8. |

PARAMETER VALUE CODES

E...ESTIMATED VALUE
H...EXCEEDS VALIDATION LIMITS
K...INSUFFICIENT SAMPLE
N...INTERFERENCE
P...RESULT QUESTIONABLE AND POOR BLANK DEPLETION
L...LESS THAN OR NOT DETECTED
Q...RESULT QUESTIONABLE
R...POOR DEPLETION IN THE BLANK
S...LABORATORY ACCIDENT
T...SAMPLE CONTAINER BROKEN IN TRANSIT
U...RESULTS APPEAR ERRONEOUS
9999....DATA NOT VERIFIED
G...GREATER THAN
V...SUSPECTED SAMPLE CONTAMINATION
W...INACCURATE RESULTS DUE TO SAMPLE AGE
X...NOT COMPLETED DUE TO LACK OF LABORATORY CAPACITY
Y...VERIFIED RESULT
Z...MACHINE MALFUNCTION